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LAUNCH OF THE UNITED STATES BATTLESHIPS KEARSARGE AND KENTUCKY.

The launch of the United States Battleships Kearsarge and Kentucky at the Newport News shipyard on March 24, was in many respects of special technical interest. Not only was it the first time that two battleships had been put into the water at the same yard on the same day, but the vessels were the heaviest ever launched in this country and are of unusual type; and besides the launch presented several peculiar points in practice.

It was very desirable that the draught of these vessels should be kept as small as possible on account of the shallowness of most of our harbors, and on this account Commodore Philip Hichborn, Chief of the Bureau of Construction and Repair, recommended that their largest guns should be only 12 in. in caliber instead of 13 in. as in the "Indiana" class. Ensign Straus proposed, and the Bureau of Ordnance adopted and advo-

LAUNCHING THE FIRST-CLASS BATTLESHIP KENTUCKY AT NEWPORT NEWS SHIPYARD.

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cated, the novel idea of two double decked turrets to each ship. In the lower part of each were to be mounted two 13-in. guns, and in the upper part two 8-in. guns.

A very vigorous discussion of the merits of this scheme raged in the newspapers and in the technical press for some time without much advantage to either side. The Department adopted the idea for these ships, but we note that in later designs it has been abandoned.

The general dimensions of the two ships are as follows:

Length on load water line	368 ft.
Beam, extreme	72 ft. 2.5 in.
Freeboard, forward	14 ft. 3 in.
Freeboard, aft	12 ft. 3 in.
Normal coal supply	410 tons
Mean draught, with coal on board	23 ft. 6 in.
Corresponding displacement	11,500 tons
Speed per hour	16 knots
Maximum coal supply	1,210 tons
Draught with 1,210 tons of coal and all stores and ammunition aboard	25 ft.
Corresponding displacement	12,325 tons

The armor protection presents points of difference from our previous first-class battleships. The water line belt of Harveyized nickel steel extends from the stem to the after barbette, instead of between barbettes only. Between barbettes its maximum thickness is 16 1-2 in. Forward of the forward barbette it tapers gradually to a thickness of 4 in. at the bow. The turret armor, instead of being of uniform thickness, is 2 in. thicker in front than elsewhere.

Each of these ships has on each side a docking keel extending from the center of the forward turret to the center of the after turret, to aid in taking the weight of the ship in dry dock. The keels in section are not unlike the letter H. The outer portion is to be filled with creosoted Indian teak. The teak has been fitted in place, but was taken out and is now away to be creosoted. At present its place for about 146 ft. amidships is taken by yellow pine, to receive the weight of the ships when they are next docked. The docking keels are 16 in. wide amidships across the face of the wood.

Unfortunately the dimensions of existing dry docks do not permit these vessels to be fitted with complete bilge keels. They have them, therefore, only at the ends, about under the turrets, so that they do not extend beyond the line of the amidship section.

Both docking and bilge keels can be seen in the starboard view of the "Kearsarge" and in the port quarter view of the "Kentucky." It happened to be more convenient for pushing the work on these ships to put the military masts in before launching, instead of later, and the masts were accordingly put in. This is the first time that this has been done in this country, and it is in any case an unusual practice. Notwithstanding the great and lofty weight of these steel masts, the vessels were launched with the very ample metacentric height of about 20 ft.

The water line belts extend so far aft that the after ends of them were very likely to be submerged in launching. To make sure of water tightness at these points, the after plate of each belt was put in the ship on the ways. Each of these plates added a weight of approximately 70,000 lbs.

The arrangement of double decked turrets will, when complete, bring great concentration of weights at two parts of each of these ships, but the work on the turrets was not far enough advanced (only the turret track supports being in when launched) to require any particular precaution on this account. Of her machinery equipment, the "Kearsarge" when launched had on board and in place only her main condensers, main circulating pumps and their sea connections, evaporators, main separators, thrust, line, and propeller shafting, double bottom suction pipes, and main and secondary drains. The auxiliary condensers, feed and auxiliary pumps, and parts of forced draft fans were in her, but not in place.

The state of affairs on the "Kentucky" was about the same, and neither ship was launched with her propellers on.

In addition to the parts of her own machinery mentioned each ship had on board, when launched, a donkey boiler mounted on the forecastle, forward of the turret, and a very complete temporary shop of small machine tools.

When launched each ship had on board two bow anchors, weighing approximately 13,200 lbs. each. Altogether the complete launching weights of the ships was estimated at 4,450 tons each.

The following table shows the principal other data of the launch, as calculated by the Government inspectors on duty at the Newport News yard:

Mean draught	10 ft. 9½ in.
Draught forward	8 ft. 7½ in.
Draught aft	12 ft. 11½ in.
Drag	4 ft. 4 in.
Center of gravity aft of midship section	2 ft. 6 in.
Center of gravity above base	12 ft.
Metacentric height (approximate)	20 ft.

Pivoting occurred when the sterns of the ships were about 263 ft. beyond the ends of the ground ways, assuming 7 ft. 7 7-16 in. depth of water over the end of the ways.

Pivot pressure	362 tons
Maximum tipping moment was negative (i. e., tended to raise the sterns)	(—) 3,152 ft. tons

The keels of the "Kentucky" and "Kearsarge" were laid on a declivity of 9-10 in. to the foot and the declivity of the launching ways was 11-16 in. to the foot, with no camber. The management of the Newport News yard holds that a ship is less likely to be strained in launching from perfectly straight than from cambered ways. The ground ways were 28 ft. across, and the breadth of each way was 4 ft. The ground ways were carried out 105 ft. from the bulkhead, or seawall. By this means the total length of run was made 565 ft., and a depth of water at the end of the ways of 26 ft. at mean low tide was provided. It will be seen from this, at Newport News vessels of the size of these battleships could if necessary

be safely launched at ordinary low tide, but in fact the "Kearsarge" and "Kentucky" were launched near high water; the "Kearsarge" on the flood, and the "Kentucky" on the ebb tide.

The usual enterprise of the management was shown by a line of 16 candle-power electric lights all along the inside of the ground ways, making the usually dark and dismal neighborhood of the keel blocks almost as light as the open day outside.

The short length and broad beam of the "Kearsarge" and "Kentucky" make their weight very concentrated—an ordinary merchantman of the same length would probably have about one-half their launching weight—and besides, their lines are rather fine for battleships, requiring about 30 ft. to be left unsupported at each end, so that the pressure per square foot on the sliding surface was not far from 2 1-4 tons.

On this account the management adopted a peculiar form of cradle, which is shown in the illustration on page 7 of the starboard bow cradle of the "Kentucky," the other cradles being similar. No poppets whatever were used. The upright pieces shown were merely toggle-braces to spread the pull of the athwartship ties vertically over the cradle, and the tops of these uprights were cut away to a clearance of about 1 in. from the bottom plating. To spread the heavy pressure as much as possible over the skin of the ship, and to minimize the risk of denting the plates, especially at the moment of pivoting, the cradles were built up solidly of yellow pine packing, of which the top tiers were cut to a snug fit with the skin of the ship. It may be remarked, incidentally, that this form of cradle is cheaper than the usual form with poppets.

The cradles formed one continuous structure with the packing under the waist. Below the wedges the packing all lay fore and aft. Above the wedges there were two fore and aft tiers of packing and then alternate tiers of athwartship and fore and aft packing. Inside and out the packing, above the wedges, was covered by a plank casing secured in place by heavy iron spikes. The fore and aft tiers and the outside casing furnished the only fore and aft ties of the packing and cradles. To spread the pressure over as much of the ships' length as possible the stern cradles were built right up to, and to fit, the propeller bosses, as shown in the illustration of the "Kentucky's" port quarter. There was no support of the stern aft of the cradle.

The only ties to prevent the cradles from splaying out at the sides were three sets of 6 in. manila hawsers of 22 to 30 parts each at each cradle. These hawsers passed from side to side under the keel and secured to the cradles as shown in the illustration of the "Kentucky's" starboard bow cradle. In accordance with present practice these hawsers were not wet before launching.

At the forward ends of the ways heavy oak backing was provided for two 100 ton hydraulic jacks at each side of each ship. Each set of sliding ways ended forward in an oak shoe, or sole-piece, 4 in. by 42 in..

Directly over the ways the double bottoms were well chocked with wood to prevent denting of the plating. Directly over these chocks a row of strong wooden shores was put in between the inner bottom and the protective deck from the stem aft only to the after fire room bulkhead. These shores were braced strongly fore and aft by diagonals extending from the inner bottom to the protective deck. They were also strongly braced horizontally against the midship longitudinal bulkhead and against the outer skin of the ship. The midship longitudinal bulkheads were put up with bolts only to stiffen the ships in launching, as they will have to be taken down in order to install the engines and boilers.

At low tide on the afternoon of March 23 the ways below the stern cradle were greased well down into the water, and the work of removing the rubbish from between the ways was begun.

The work of preparing for the launch was taken up again at 4.00 A. M. on March 24. The time from then until 7.00 A. M. was occupied in clearing up and in organizing the men for the work in hand.

The "Kearsarge" was to be launched first, and the "Kentucky" was to follow as soon as possible. Soon after 7.00 A. M. the "Kentucky's" packing was therefore given a good setting up for about eight minutes. This was done simultaneously all along both sides by gangs of four men each with oak battering rams, there being as many rams along each side as the space would allow to work.

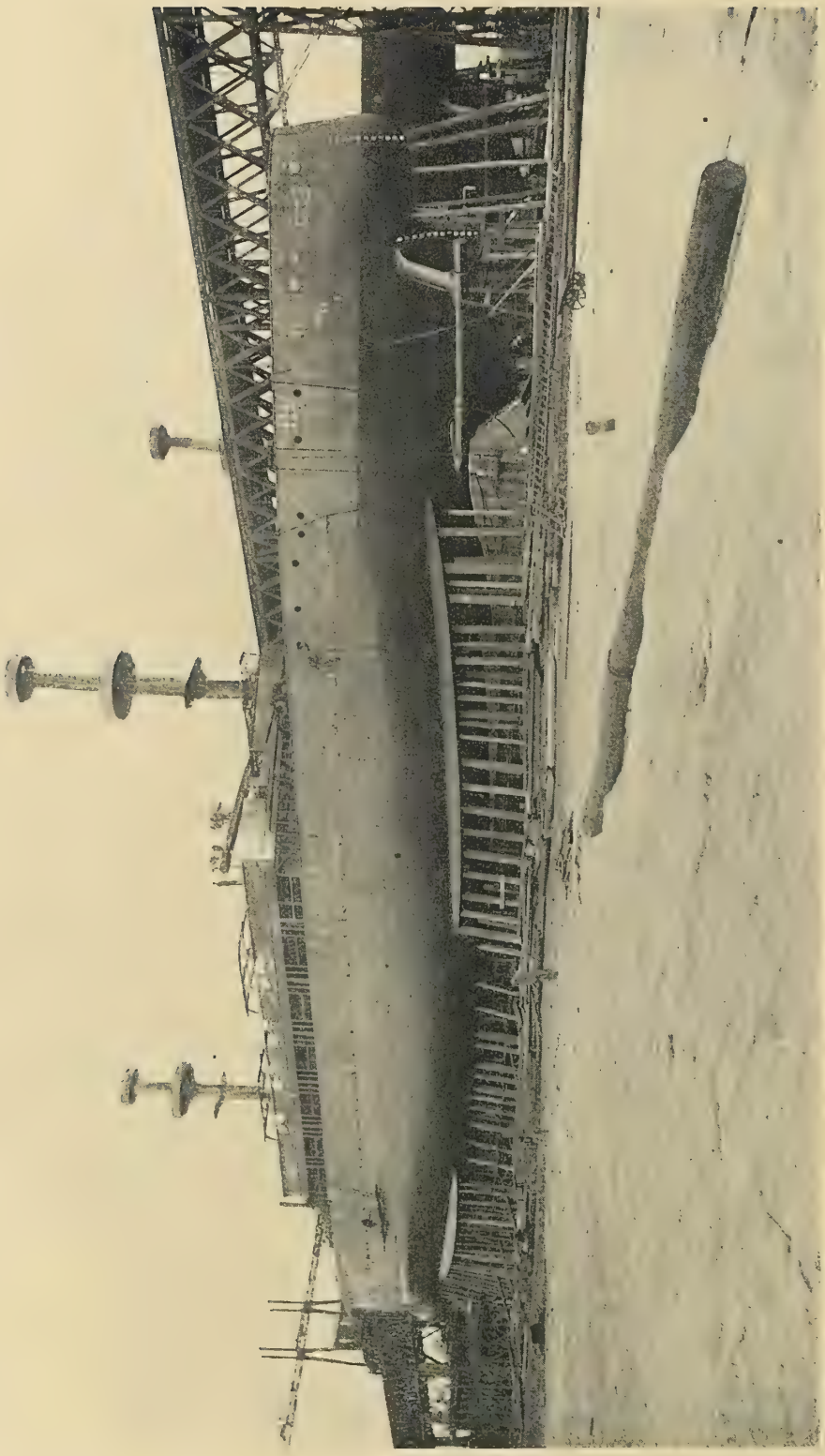
The gangs then moved over to the "Kearsarge" and gave her packing a similar setting up about 7.30 o'clock.

The boards covering the "Kearsarge's" ground ways, inboard of the sliding ways, were then ripped off, and negro boys set to work to scrape off the exposed grease, as it had become full of chips and dirt.

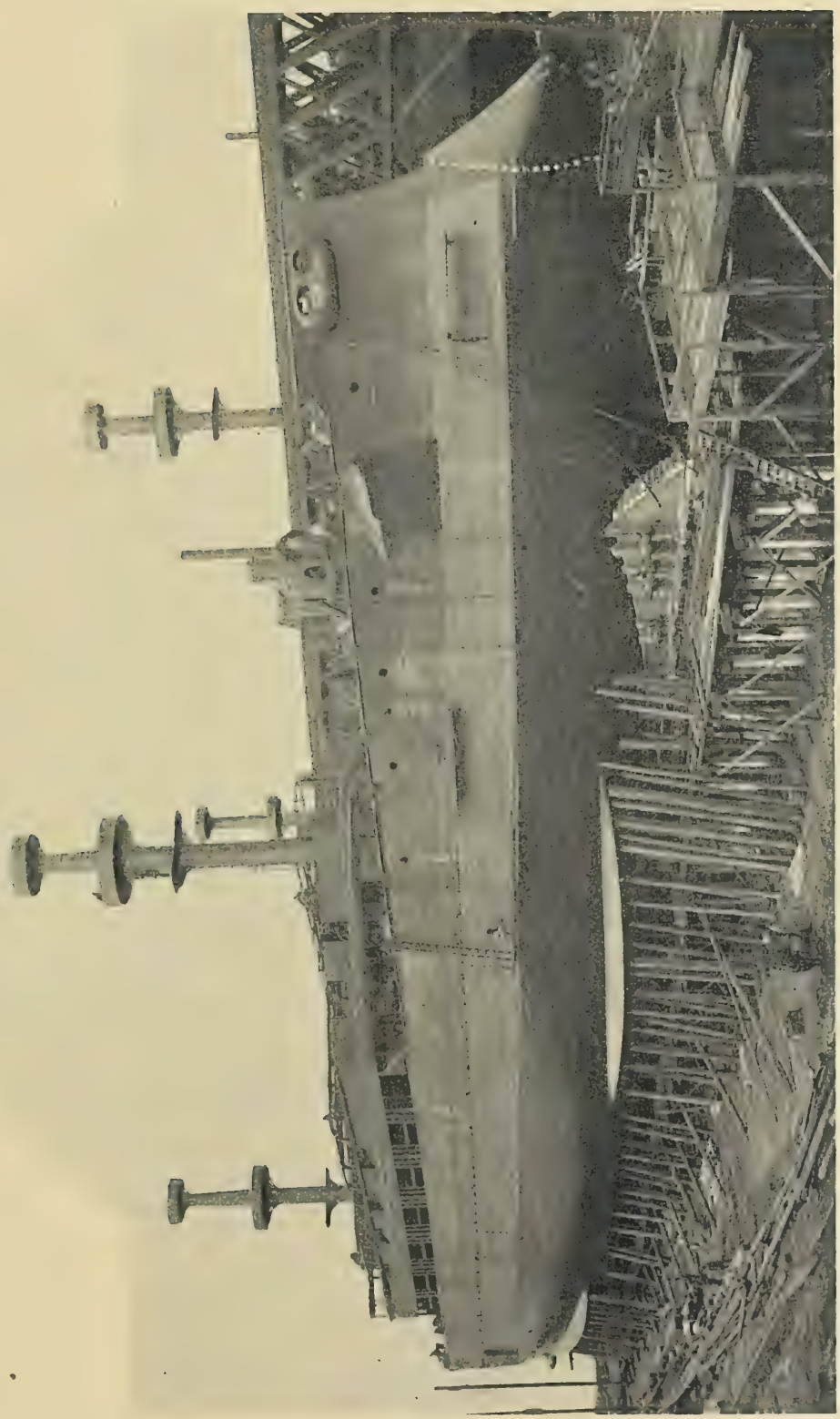
As plenty of time had been allowed in order to be sure of launching on time, there was now a period of waiting and comparative idleness. This brought out strongly the eagerness and enthusiasm of the men, for, at the sound of a hammer, or anything of that sort, they would set to work with their rams all along the ways and pound until word was passed to knock off. At 8.00 A. M. the four 100 ton hydraulic jacks were put in place at the head of the "Kearsarge's" ways.

At 8.30 A. M. a gang started to take down the shores (except trip-shores) between the ways of the "Kearsarge." Throughout the preparations for launching a gang of painters followed and wherever a shore or keel-block was knocked out, a careful examination of the plating was first made for empty rivet holes, dents, and so on, and everything being found correct, the freshly exposed plating was given a coat of paint.

At 8.53 A. M. the shores (except trip-shores),



PORT QUARTER VIEW OF THE U. S. FIRST-CLASS BATTLESHIP KENTUCKY BEFORE LAUNCHING AT THE NEWPORT NEWS SHIPYARD.
(Photographed for Marine Engineering by Rush & Shaw, Newport News, Va.)



STARBOARD BOW VIEW OF THE U. S. FIRST-CLASS BATTLESHIP KEARSARGE BEFORE LAUNCHING AT THE NEWPORT NEWS SHIPYARD.
(*Photographed for Marine Engineering by Rush & Shaw, Newport News, Va.*)

between the ways, and the 'thwartship wooden struts between the cradle and between the cradles and the hull had all been removed, but a full line of shores was still in along the bilges. The work of splitting out the "Kearsarge" keel blocks was then begun.

At 9.05 A. M. gangs with battering rams began knocking out the shores along the "Kearsarge's" bilges.

At 9.35 A. M. the only keel blocks left were under about one-quarter of the "Kearsarge's" length, clear forward, and more than half the bilge shores were also out. Men were, therefore, then stationed with saws at the shores on both sides to cut her loose if she should start to go.

At 9.54 A. M. the last bilge shore was out.

At 9.57 1-2 A. M. the saw began on the shoes just as the last keel blocks were being split out from under her fore-foot.

The ship started down the ways at 10.01 1-4 o'clock.

As she started, Mrs. Winslow, wife of Lieutenant-Commander Herbert Winslow, U. S. N., the son of the officer who commanded the old "Kearsarge" in her fight with the "Alabama," threw a bottle of wine against the ship's bow and exclaimed, "I christen thee Kearsarge." To prevent a miss the wine bottle had been hung on a line from a pole stuck through the hawse-hole. It hit its mark and broke in foam on the bow.

The launch and christening were entirely successful. The "Kearsarge" sped down the ways with a maximum velocity of 11.49 knots, and was fully waterborne in 57 seconds.

The twenty-one oak trip shores under the keel of the "Kearsarge" aft had been made with their forward upper and after lower corners well rounded off, so that the ship herself knocked them down as she went down the ways.

Owing to the great expanse of water formed by the James river estuary at Newport News, no drags whatever are required in launching there, and none were used on either of these ships.

The "Kearsarge" was taken in tow by several local tugs and made fast to a pier at the southern extremity of the yard.

Work was immediately begun on the "Kentucky." The fact that her packing had been previously set-up, as mentioned above, expedited matters somewhat; otherwise her launch was a repetition of that of the "Kearsarge" and need not be described in detail.

She started at 11.36 o'clock and went down the ways with a maximum velocity of 12.26 knots and she was fully waterborne in 46 seconds. The maximum dips of the sterns of both ships was 17 ft. Miss Catherine Bradley, daughter of Governor William O. Bradley of Kentucky christened the ship with spring water. To remove any ill luck that might follow such a spiritless christening the Kentucky visitors saluted their State's namesake, as she started down the ways, with a fusillade of bottles of good old Bourbon, none of which was observed to miss.

After launching the "Kearsarge" hogged about 1-8 in., and the "Kentucky" about 1-4 in.

No expansion joints or other means of accommodation to change of shape were provided in the upper works of either ship.

The ships are about 58 per cent. completed and can be finished in one year more by working day and night; otherwise they will be ready in from one and a half to two years.

Their armor has all been delivered and is ready to put on. The engines are complete and are set up in the erecting shed. The boilers are also complete and are in the yard ready to put in. The yard's new 140 ton electric jib crane will not be ready for use for two or three months yet, but the work can go ahead with the yard shear legs.

The propelling engines of these two ships are rights and lefts, placed in two water tight compartments and separated by a middle line bulkhead. These engines are of the vertical inverted cylinder direct-acting, triple-expansion type. The collective I. H. P. of the propelling, the air pump and the circulating pump engines will be 10,000, when the main engines are making about 120 revolutions per minute. When in position the H. P. cylinder of each engine will be forward and the L. P. cylinders aft. The framing of the engines consists of wrought steel columns trussed by wrought steel stays. The engine bed plates are cast steel, supported on keelson plates. The condensers are composition and steel. For each propelling engine there will be a double vertical, single-acting air pump, worked by two inverted steam cylinders. The main circulating pumps will be of the centrifugal type, one for each condenser, worked independently. The propellers will be right and left of manganese bronze. Each engine room will have an auxiliary condenser, made of composition, and connected with all the auxiliary machinery. Each of these condensers will have a combined air and circulating pump.

There will be three double ended main and two single ended auxiliary steel boilers of the horizontal return fire-tube type, in each vessel, all constructed for a working pressure of 180 lbs. per square inch. The thickness of shell plates is 1 7-16 in. The boilers will be placed in four water tight compartments. There will be two athwartship fire rooms in each of the main boiler compartments. The mean outside diameter of all boilers is about 15 ft. 6 1-2 in. The two forward double ended boilers are about 19 ft. long, the after double ended boilers are about 21 ft. long, and the single ended boilers about 9 ft. 11 1-2 in. long. There will be two smoke pipes. Forced draught will be on the closed fire room system. The outfit of auxiliaries will be as usual, except that the turrets will be operated by electricity.

The contract price of the ships is $2,500,000 each, without any speed premium.

The work on the battleship Illinois at this yard is well along, and she will probably be launched in from four to six months more.

Emergency Torpedo Boats.

Due to the failure of the Government to secure enough torpedo-boats abroad, the Secretary of the Navy recently directed the Chiefs of the Bureaus of Construction and Repair and of Steam Engineering to report to him the number, displacement and cost of torpedo-boat destroyers and torpedo-boats which should be built by this government. These officials reported in favor of 100 torpedo-boats of about 100 tons displacement and of between 20 and 22 knots speed. The recommendation was limited to these, because it was estimated that they could be completed at least one month sooner than any others. Such boats would be capable of harbor defence only, being too small to go to sea to any extent.

On this account there was considerable opposition, especially from the Assistant Secretary of the Navy, Mr. Roosevelt, to building this type alone. The Secretary, therefore, reported to the President in favor of about thirty destroyers of from 325 to 350 tons displacement and of thirty knots speed, and of about seventy of the smaller boats.

The President has the matter under consideration; and it is expected that he will authorize the expenditure of about $7,000,000 for these boats.

It is estimated that the torpedo-boats can be completed within ninety days, and the destroyers within four or five months.

The department is thoroughly informed as to what the shipbuilders of the country can and will do in the matter; and the Bureaus of Steam Engineering and Construction and Repair have already prepared contracts for the hulls and machinery, so that the contracts can be let as soon as the President's decision is formally announced.

Naval Appropriation Bill.

The Naval Appropriation bill was reported to the Senate on April 12 by the Appropriations Committee. The bill had already passed the House; but the Senate Committee increased the aggregate appropriation by $8,263,500, making the total $46,277,558.

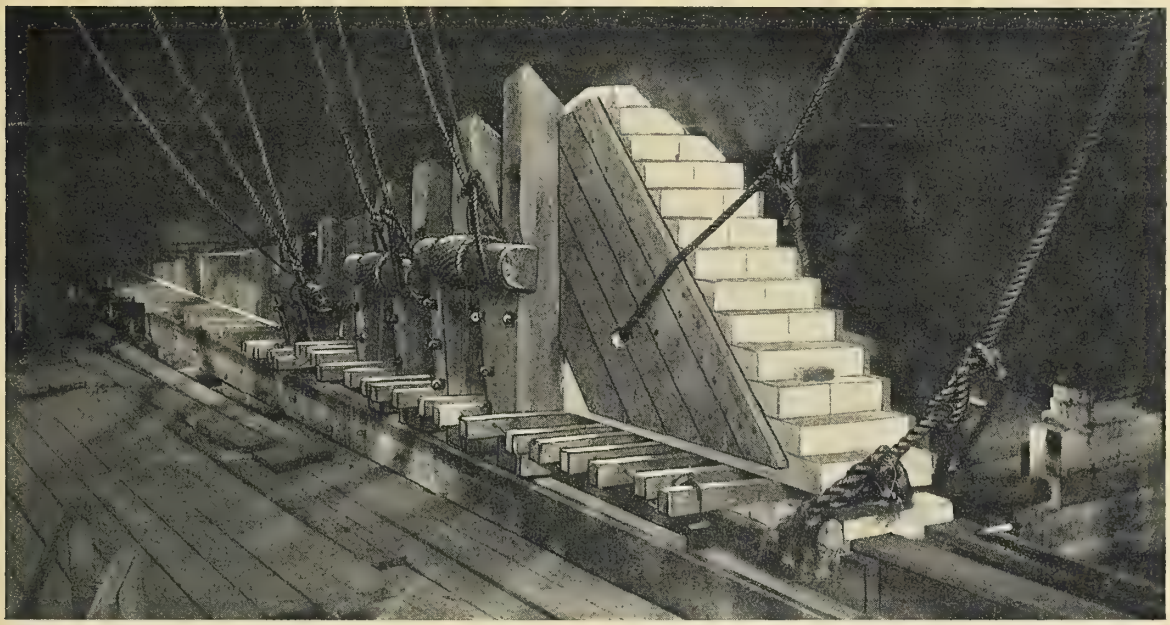
The principal provisions of the bill as reported to the Senate are as follows:

The President is authorized to have constructed by contract three sea-going coast-line battleships, designed to carry the heaviest armor and the most powerful ordnance upon a displacement of about 11,000 tons, to have the highest speed practicable for vessels of their class, and to cost, exclusive of armor and armament, not exceeding $3,000,000 each, one of said battleships to be named the Maine; four harbor defense vessels of the monitor type, to cost, exclusive of armament, not more than $1,250,000 each, and to have one or two turrets each; sixteen torpedo-boat destroyers of 400 tons and twelve torpedo-boats of 150 tons displacement, to have the highest practicable speed, and to cost, exclusive of armament, not exceeding $6,900,000; one gunboat to replace the U. S. S. Michigan, stationed on the Great Lakes, to be built on the Great Lakes or connecting waters, and to cost, exclusive of armament, not more than $260,000.

The four harbor defense vessels and four torpedo-boat destroyers were added to the House bill by the Senate Committee.

One of the harbor defense vessels is to be built on the Pacific coast. Not more than two of the battleships, two of the monitors or five of the torpedo-boat destroyers are to be built at any one yard.

A sum of $7,162,000 is appropriated for the



CONSTRUCTION OF THE LAUNCHING CRADLES FOR BATTLESHIPS KEARSARGE AND KENTUCKY.

armor and armament of the vessels authorized, and $375,000 for their equipment.

To the paragraph of the House bill authorizing four timber dry docks, one each at Portsmouth, N. H., Boston, League Island, Pa., and Mare Island, Cal., a provision is added allowing the Secretary of the Navy, in his discretion, to have one of them built of granite or of concrete faced with granite, in which case the limit of cost is raised by $200,000.

Improvements to the naval station at Port Royal, S. C., are provided for in an appropriation of $330,000, of which the principal items are $100,000 for dredging a channel to the station; $75,000 for a new wharf, adjoining the dry dock, and $50,000 for a machine plant capable of repairing boilers and engines of United States naval vessels.

The enlistment of 2,000 additional men for the navy is authorized, and the House provision for enlistment is stricken out and the following substituted:

"And whenever, within the next twelve months, an exigency may exist which, in the judgment of the President, renders their services necessary, the Secretary of the Navy is hereby authorized to appoint from civil life and commission such acting officers of the line and staff, not above the rank or relative rank of lieutenant, as may be requisite; provided, that such officers shall serve only during the continuance of the exigency under which their services were required; and provided further, that such officers so appointed shall be assigned to duty with rank and pay of the grades established by existing laws."

$500,000 is appropriated for improvements to the naval academy, and contracts for the same are authorized to the amount of nearly $1,000,000, of which the following are the most important: New armory, cost not to exceed $300,000; new boathouse, cost not to exceed $300,000; new power-house, cost not to exceed $100,000; four double houses for officers' quarters, cost not to exceed $60,000; grading, electric light wiring, renovating old buildings and preparing plans, not to exceed $90,000.

To repair the damage done to the navy yard, Mare Island, Cal., by the recent earthquake, $350,000 is appropriated, and $50,000 is appropriated toward a naval training station for apprentices on Yerba Buena Island, San Francisco Bay, Cal., which is to cost $100,000.

The Secretary of the Navy is authorized to have the Yantic, the training ship of the Michigan naval militia, repaired out of the appropriation for that body. For a steam water boat for the Norfolk Navy Yard, $6,000 is appropriated.

The royalty for steel face hardening is limited to one-half cent per pound.

The bill provides for the transfer of the hydrographic office, Navy Department, from the Bureau of Navigation to the Bureau of Equipment.

The smokeless powder clause was stricken out.

REGULATIONS FOR THE APPOINTMENT OF NAVAL ENGINEER OFFICERS FROM CIVIL LIFE.

The most serious need of the Navy at the present moment is a sufficiency of skilled marine engineers. This has at last been recognized by Congress, and in the Naval Appropriation bill the following clause was inserted:

And whenever, within the next twelve months, an exigency may exist which, in the judgment of the President, renders their services necessary, the Secretary of the Navy is hereby authorized to appoint from civil life and commission such active officers of the line and staff, not above the rank or relative rank of lieutenant and warrant machinists, as may be requisite: Provided, that such officers shall serve only during the continuance of the exigency under which their services are required: and provided further, that such officers so appointed shall be assigned to duty with rank and pay of the grades established by existing law.

While applicants for any seagoing corps of the service (line, engineer, medical and pay) may be appointed under this proposed law, the most urgent need, as stated, is for engineer officers, and plans have been made to form a volunteer corps of engineer officers, with acting appointments.

Anticipating the passage of this provision of law, the Navy Department has issued instructions dividing applicants into four classes:

First.—Ex-graduates of the Naval Academy.

Second.—Ex-naval cadets, not graduates.

Third.—Officers of merchant marine and naval militia.

Fourth.—All others.

(1.) When an applicant is selected for appointment, he shall be ordered by the detail officer to appear for such examination as may be requisite.

(2.) Line and engineer officers shall pass physical and professional examinations and file recommendations as to sea experience.

(3.) Appointees to be selected as the Secretary may direct.

All merchant ships recently purchased by the government will be manned in the machinery department by volunteer engineers. Indeed, so urgent was the necessity that five engineers of the American liner St. Paul, after purchase by the government, were offered commissions immediately and without examination, before any authority of law had been passed.

The proposed commissioned grades to be established in the Engineer Corps are as follows:

Chief Engineer, with the relative rank of Lieutenant.

Passed Assistant Engineer, with the relative rank of Lieutenant.

Passed Assistant Engineer, with the relative rank of Lieutenant of the Junior Grade.

Assistant Engineer, with the relative rank of Ensign.

Candidates for appointment as volunteer engineer officers should address their applications to the Chief of the Bureau of Steam Engineering, Washington, D. C. Permission to appear for examination will be given those who are suited for the service. The professional examination

will be conducted before a board of regular engineer officers, convened at the Postoffice Building, Philadelphia, Pa., for the purpose. The physical examination will be before a board of medical officers in the same city.

We here reproduce the general form granting permission to applicants to appear for examination for a commissioned officer for either line or staff; the blank spaces are of course to be filled in at the Bureau of Navigation according to the position applied for:

Address Bureau of Navigation, Navy Department, and refer to No.....

WASHINGTON, D. C., ...

Sir:

A Naval Examining Board and a Medical Board are now in session at ..... for the examination of candidates for admission into the United States Navy as Acting .....

You have permission, if of full age and a citizen of the United States, to present yourself to the Medical Board for examination as to your physical qualifications for the naval service.

If found to be physically qualified, you are authorized to report to the President of the Naval Examining Board for examination as to your professional and moral qualifications, and if in all respects qualified, an appointment as an Acting ..... will be given you when your services shall be required.

You will present this letter to the Boards.

Please keep this Bureau informed of your address.

Respectfully,

.....

Chief of Bureau.

It will thus be seen that no way is yet open for the appointment of any engineers from civil life to permanent commissioned rank in the Navy. There is, however, an opportunity for marine engineers, mechanics and subordinates who wish to enlist in the Navy to secure appointments as "machinists," of various grades or as mechanics or as firemen. Under ordinary circumstances enlistments are for three years, but in the present emergency enlistments are made for one year, with the understanding that the men may withdraw or be discharged inside of that time should their services be no longer required. Usually also an engineer cannot enlist as a "chief machinist," but must work up from the lower ratings, but now if in possession of first-class marine papers he will be eligible for the rank of "chief machinist."

All applicants for enlistment in the naval service must be of robust frame, intelligent, of perfectly sound and healthy constitution and free from serious physical defects. Following are the ratings:

Chief machinist.....	pay $70 per month
Machinist:	
1st Class	" 55 " "
2d Class	" 40 " "

A candidate for enlistment must know the names and uses of the various parts of a marine engine and boilers, and must be able to perform work with various tools in a machine shop, including bench work. He must be able to write legibly and must understand arithmetic; and at the date of first enlistment must not be less than twenty-one nor more than thirty-five years of age.

Machinists who have had no experience at sea with marine engines will be enlisted as "machinists, second class." Those who have had experience at sea with marine engines for one year may be enlisted as "machinists, first class."

No person will be enlisted as chief machinist unless he holds a permanent appointment as such.

The examination of candidates for enlistment as machinists, regarding their knowledge of engines and of boilers, must be made in the engine rooms of ships; and regarding their knowledge of machine work, in the workshops of navy yards.

Chief machinists will have charge of engine-room watches. Machinists, first class, will, if qualified, be given charge of an engine-room watch when there are not a sufficient number of chief machinists on board to perform this duty.

Machinists, second class, will be assigned to duty as water tenders and oilers. All machinists will perform such other duties as may be assigned them.

Boilermaker.—Limit for age, 21 to 35 years. Must thoroughly understand his trade. Pay, $60 per month.

Blacksmith.—Limit for age, 21 to 35 years. Must be able to pass a rigid examination as to physical and mechanical qualifications. Pay, $50 per month.

Coppersmith.—Limit for age, 21 to 35 years. Must thoroughly understand his trade. Pay, $50 per month.

Plumber and Fitter.—Limit for age, 21 to 35 years. Must be thoroughly qualified to fill the rating. Pay, $45 per month.

Fireman, First Class.—Age, 21 to 35 years. Must have had experience as fireman on a steamer and must know about marine engines and boilers and their attachments. He must thoroughly understand the management of the fires, how to regulate and use the different valves on the boilers and the different pumps. He should know how to put on a soft patch, and be able to wrap pipes to stop a leak. He must know how to pack the stuffing boxes around the engines and how to grind in valves, etc. He must also understand about oiling the working parts of an engine. The pay is $35 per month.

Firemen, first class, are eligible for the rating of water tender, $40, and oiler, $37 per month.

Fireman, Second Class.—Limit for age, 21 to 35 years. Must have had experience as a fireman, preferably on board a steamer, and must understand the working of fires. He should know something of the engines, the different pumps, the boilers and the attachments to the boilers, and their uses. The pay is $30 per month.

Coal Passer.—Limit for age, 21 to 35. Candidates should preferably have had some experience in firing either on shore or in steamer. The pay is $22 per month.

Men of all ratings are entitled to one ration or three meals per day. Applicants must present themselves on board receiving ships at the navy yards for examination, previous to enlistment, at their own expense. These are located at Boston,

Mass.; Navy Yard, New York; League Island, Philadelphia; Norfolk, Va., and Mare Island, San Francisco, Cal. No money is allowed for traveling expenses. Preference will be given to applicants who can read, write and are American citizens by birth or naturalization, or who have declared their intentions to become American citizens. No person can be enlisted who does not understand and speak the English language.

As this issue goes to press, dispatches from Washington say the Secretary of the Navy will be authorized to appoint an unlimited number of warrant machinists, to act as engineers, at $1,200 per annum.

STRENGTH OF THE SPANISH NAVY BROUGHT DOWN TO DATE.

On account of the number of inquiries we have received relative to the strength of the Spanish Navy we have prepared a series of reference tables which are printed herewith. It is hardly necessary to say that unless such tables are intelligently used they are more likely to produce wrong impressions than impart accurate information. The ships have been grouped in various classes, permitting some comparison with the strength of the several classes of our own Navy, reference tables of which were published in our March issue. The refinements of armor and armament have not been gone into, both for the reasons that they would complicate the tables and that they would be of little real value to any but an ordnance expert. The date of build of a vessel, which is given in each case, affords a line upon her equipment in these respects, although, so far as armament is concerned, old vessels might be equipped with very modern guns. Armor varies, not only in thickness, but in the quality of resisting penetration, so that a comparatively thin armor plate of modern make would be much more effective than a very much heavier plate of old-time armor plate. The same rule applies to weapons, the improvements in main and secondary and machine gun batteries having been very considerable since the introduction of the ironclad in naval construction. Then speed is a very important factor in determining the efficiency of a navy, or fleet, intended for deep water operations, for speed, of course, means manoeuvring capacity. It will be noticed that in point of numbers the Spanish Navy is strong. As to its quality, there are about fifty vessels on the active list ranging in displacement from 500 tons upward to 9,900 tons, which might be considered as formidable. Then the torpedo fleet, including the splendid destroyers recently built on the Clyde for Spain, would be next in destructive capabilitiy. For the rest the Navy is composed largely of small gunboats, mostly of light draught, for use in river or patrol work in shallow waters. The only out-and-out battleship possessed by Spain is the "Pelayo," a heavily armored and armed vessel of rather antiquated type, having been built in France in 1887, and lately undergone extensive alterations there. There are also nine armor plated cruisers and five cruisers with protective decks. The former include six fast ships, each carrying guns as heavy as 11 in. and a considerable thickness of armor, and possessing high speed. This type was represented by the warship Vizcaya which lay in New York harbor not long ago. Many of the ships are antiquated, especially the smaller gunboats. The Spanish Navy is not all a home product, but contains a large number of ships built in Britain, France and Italy. The large guns are mostly of the Hontoria pattern, while there is a fair proportion of Armstrong and Krupp weapons in the batteries of the fleets. The machine guns include the automatic Maxim type. It should not be forgotten that the tables represent the Spanish Navy on paper, and a liberal allowance might be made in practice for mishaps, unreadiness for sea, ships undergoing repair, and other factors which would affect the strength of the Navy.

STEEL AND IRON ARMORED SHIPS.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
ARMOR ABOUT 12 IN.—	ft. in.	ft. in.	ft. in.	Tons.	Knots.	
AlmiranteOquendo, '91	340	60	21 6	6,800	20	13,000
Cardenal Cisneros, '96	347 10	61	22	7,000	20	15,000
Infanta Maria Teresa, 90	340	65	21 6	7,000	20.20	13,500
Pelayo, '87	330	66	24 11	9,900	16	9,000
Princesa de Asturias, '96	347 10	61	21 10	7,000	20	15,000
Vizcaya, '91	340	65	21 6	7,000	20.5	13,000
ARMOR 2 IN. TO 5 IN.—						
Emperador Carlos V., '95	380	67	25	9,000	20	18,000
Pug-cerda (monitor), '74	128	29 6	6 6	550	8	330
Numancia, '63 (reconstructed '97)	314	54	25	7,300	12	....
Vitoria, '65 (reconstructed '97; training ship).	318	55 10	25 2	7,100	12	4,500
Cristobal Colon, '96	328	59 9	23 3	6,800	19.35	10,670

STEEL PROTECTED CRUISERS.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	ft. in.	ft. in.	ft in.	Tons.	Knots.	
Alfonso XIII, '91	318 6	50 6	20	5,000	20	11,000
Isla de Cuba, '87	185	30	11 6	1,030	16	2,200
Isla de Luzon, '87	185	30	11 6	1,030	16	2,200
Lepanto, '92	318 6	50 6	20	4,800	20	12,000
Marques de la Ensenada, '90	185	30	11 6	1,030	16	2,200

UNARMORED STEEL CRUISERS—NOW USED AS TRANSPORTS.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	ft. in.	ft. in.	feet	Tons.	Knots.	
Alfonso XII, '87	278 10	42 8	16	3,090	17.5	4,800
Reina Christina, '86	282	42 7	16	3,400	17.5	4,750
Reina Mercedes, '87	279	42 7	16	3,200	17.5	4,700

Unarmored Iron Cruisers

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	feet	feet	ft. in.	Tons.	Knots.	
Conde de Venadito, '88	210	32	12 6	1,140	13.5	1,550
Don Antonio de Ulloa, '87	210	32	12 6	1,140	13.5	1,550
Don Juan de Austria, '87	210	32	12 6	1,140	13.5	1,550
Infanta Isabel, '85	210	32	12 6	1,140	13.5	1,550
Isabel II, '86	210	32	12 6	1,140	13.5	1,550
Jorge Juan, '76	203	30	12	935	13	1,100
Velasco, '81	210	31	12 6	1,140	14	1,500

Unarmored Steel Gunboats.

Name and Date	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	ft. in.	ft. in.	ft. in.	Tons.	Knots.	
Alvarado, '95	110	15 6	5 4	100	10	....
Diego Velasquez, '95	135	19	6 6	200	12	....
Hernan Cortes, '95	155	21 6	6 6	300	14.5	....
Macmahon, '87	90 6	13 5	4 3	115	10	150
Pizarro, '95	155	21 6	6 6	300	14.5	....
Ponce de Leon	135	19	6 6	200	12	....
Sandoval, '95	110	15 6	5 4	100	10	....
Vasco Nunez de Balboa, '95	155	21 6	6 6	300	14.5	....
Six gunboats, '95	114 9	16 5	8 2	135	10	220
Six gunboats, '95	75	12	6 3	40	11	....
Two river boats, '96	94	25	3 4	90	10	175
Six gunboats, '87	114	17 6	6	137	10	....
Three gunboats, '93	75 5	13 2	3 10	45	9	....
Three gunboats, '87	78 9	12 10	Light	48	13	....
Eight gunboats, '95	77	11 2	Light	43	11	....
Two gunboats, '93	85	13	5 10	71	12	270

Unarmored Iron Gunboats.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	ft. in.	ft. in.	ft. in.	Tons.	Knots.	
El Cano, '85	158	26	8 6	525	11	600
Fernando el Catolico (torpedo school ship), '75	157 5	25 7	8 5	500	10	550
General Concha, '83	157 5	25 7	8 6	520	11	600
General Lezo, '85	158	26	8 6	525	11	600
Magellanes, '85	157 5	25 7	8 6	520	11	600
Marques del Duero, '75	157 5	25 7	8 6	500	10	550
Argos (survey vessel), '80	155 4	22 2	12 6	508	7	300
Alsedo, '82	115	22	6 3	216	9	250
Eulalia, '82	115	22	6 3	216	9	250
Pilar, '81	115	22	6 3	216	9	250
Salamandra, '75	111	21	5 6	190	8	210
Leyte, '75	100	....	....	150	10	120
Calamianes, '86	91 9	16 5	6 6	150	8	120
Mariveles, '86	98 5	16 5	6 6	142	10	120
Mindoro, '85	98 5	16 5	6 6	142	10	120
Two gunboats, '95	78	....	....	65	11	20
Two gunboats, '95	60	....	....	30	9	....
Delgado Parejo, '95	97 6	....	....	85	12	....
Urdanete, '84	60	9 9	3 10	28	7	40
Vasco, '83	60	9 9	3 10	28	7	40
Tarifa, '79	60	13 2	4 3	46	7	65
Otalora, '81	82	13	5	37	8	40
Guardoqui, '84	69	13	5 3	41	8	40
Esperanza, '95	58 6	13	4 6	23	10	....

Composite Gunboats.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	ft. in.	ft. in.	ft. in.	Tons.	Knots.	
Quiros, '95	145 4	22 10	10 8	348	12	500
Villalobos, '96	145 4	22 10	10 8	348	12	500

Steel Torpedo Gunboats.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	ft. in	ft. in.	ft. in.	Tons.	Knots	
Don Alvaro de Bazan, '97	235	26 2	10	830	19	3,500
Dona Maria de Molina, '96	235	26 2	10	830	19	3,500
Destructor, '87	192 6	25	7	420	22	3,800
Filipinas, '92	232 10	27	8 6	750	20	4,600
Galicia, '91	190 3	23	10 4	570	19	2,600
Marques de la Victoria, '97	235	26 2	10	830	19	3,500
Marques de Molins, '91	190 3	23	10 4	570	19	2,000
Martin Alonzo Pinzon, '92	190 3	23	10 4	570	19	2,600
Nueva Espana, '89	190	23	11 9	630	18	2,600
Rapido, '91	190	23	10 4	570	18	2,600
Temerario, '89	190 3	22 10	10 4	570	20	2,600
Vincente Yanez Pinzon, '89	190 3	22 10	10 4	570	19.5	2,600

Steel Torpedo-Boat Destroyers.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	feet	ft. in.	ft. in.	Tons.	Knots.	
Audaz, '97	225	22 6	5 9	400	30	7,500
Furor, '96	220	22	5 6	370	28	6 000
Osado, '97	225	22 6	5 9	400	30	7,500
Pluton, '97	225	22 6	5 9	400	30	7,500
Proserpina, '97	225	22 6	5 9	400	30	7,500
Terror, '96	220	22	5 6	370	28	6,000

Steel Torpedo Boats.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	ft. in.	ft. in.	ft. in.	Tons.	Knots.	
Twelve 1st-class, '83 to '87	105 to 147	10.9 to 14.5	3.3 to 6	57 to 108	19 to 26	660 to 1,000
Three 2d-class, '78 to '83	43.5 to 84.5	9.7 to 10.7	2.3 to 4.6	25 to 33	8 to 19	175 to 450
One submarine, '89	70	8 5	....	87	10	60

Cruisers with Wooden Hulls.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	feet	feet	feet	Tons.	Knots.	
Aragon, '79	246	46	21	3,342	14	4,400
Castilla, '81	246	46	21	3,342	14	4,400
Navarra (cadet train'g ship), '81	246	46	21	3,342	14	4,400

Wooden Steam Vessels Carrying Guns.

Name and Date.	Length	Beam.	Draft.	Displacement.	Speed.	I. H. P.
	feet	feet	ft. in.	Tons.	Knots.	
Albay, '86	100	....	....	250	9	....
Cocodrillo, '75	111	21	5 10	250	6	....
Cuba Espanola, '70	115	22	4 10	225	9	130
Indio, '69	108	22	6 3	200	10	....
Pelicano, '75	111	21	6 10	345	6	....
Prosperidad	140	23	9 6	415	6	130
Prueba, '77	82	15	7 10	122	8	108
Five gunboats, '69	108	22	5 7	179	7	138
Seven small vessels, rang'g from 40 to 150 tons	....	....	....	....	....	....

MISCELLANEOUS SPECIAL SERVICE VESSELS, MOSTLY OBSOLETE.

Name and Date.	Material.	Service.	Displacement.	Speed.	Propulsion
			Tons.	Knots.	
Almansa, '64	Wood	Train'g ship	4,000	7	Screw
Asturias, '57	"	Cadet scho'l	1,500	7	"
Blanca, '59	"	Train'g ship	2,500	7	"
Carmen, '61	"	"	3,100	8	"
Gerona, '64	"	Gun'y sch'l	4 000	9	"
Lealtad, '60	"	Train'g ship	3,000	9	"
Nautilus, '68	Composite	Cadet training ship	800	..	Sail
Tornado, '66	"	Torpedo sc'l	2,000	9	Screw
Urania, '95	Steel	Dispatch b't	670	..	"
Ville de Bilbao, '47	Wood	Train'g ship	1,200	..	Sail
Zaragoza, '67	Wood (armored)	Torpedo school	5,600	8	Screw
Six tugs	Wood and iron	....	....	..	Scr'w & paddle

AUXILIARY VESSELS—ARMED TRANSPORTS AND CRUISERS.

Name and Date.	Length	Beam.	Depth.	Tonnage.	Speed.	N.H.P.
	ft. in.	ft. in.	ft. in.	Gross.	Knots.	
Alfonso XII, '88	438 5	48 8	24 9	5,063	15	700
Alfonso XIII, '88	400	48	....	4,381	16	....
Buenos Aires, '87	410 6	48 2	....	5,195	14	....
Cataluna, '83	384 2	42 2	27 5	3,488	14	750
City of Richmond, '73 (formerly Inman Liner)	440	43 5	34 1	4,989	....	700
Ciudad de Cadiz, '78	363 6	38 2	24 2	3,084	13.5	700
Cuidad Condal, '72	316 5	38 2	28 3	2,596	....	....
Isla de Luzon, '82	381 9	44 2	....	4,252	13	....
Isla de Mindanao, 81	376 5	42 3	26 2	4,195	13.5	....
Isla de Panay, '82	362 4	43 2	....	3,636	13.5	....
Leon XIII, '90	410 4	46 1	....	4,687	15	....
Magallanes, '81 (formerly Guion Liner Alaska)	500	50	38	6,932	18	I. H. P. 10,500
Monte Video, '89	410 5	48 2	....	5,096	14.5	....
P. de Satrustegui, 90	410	46 1	....	4,638	15	....
Five merchant steamers	....	....	....	500 to 1,500	7 to 10	....

WARSHIPS NOW UNDER CONSTRUCTION.

Name.	Length	Beam.	Draft.	Displacement.	Speed.	I.H.P.
	ft. in.	ft. in.	ft. in.	Tons.	Knots.	
Armored cruiser ..	....	....	...	11,000	19	....
Armored cruiser ..	....	....	....	10,000	21	....
Cataluna (armored cruiser)	347 10	61	22	7,000	20	15,000
Pedro d'Aragon (armored cruiser)	328	59 8	24	6,850	20	13,000
Reina Regente (protected cruiser)	337 10	52 6	19 9	5,400	20	....
Rio de la Plata (protected cruiser)	246	35 5	14 3	1,775	20	7,000
Unarmored cruiser	....	....	....	1,800	20	....
Veloz (torpedo gunboat)	213	27	8 6	750	20	4,500
Cadet training ship	....	....	....	3,000	....	....

New Revenue Cutter for the Yukon.

The Treasury Department has received at the headquarters of the Revenue Cutter Service in Washington, the drawings of the hull of a new revenue cutter for which an appropriation has been made by Congress. She was designed on the west coast, especially for service on the Yukon River; the hull by Captain C. S. Hooper, United States Revenue Cutter Service; and the engines by Chief Engineer James A. Doyle, United States Revenue Cutter Service.

The vessel is to be a flat bottomed stern-wheel steamer, and is to be built of wood. She is to be 160 ft. long on the load water line, and 174 ft. long over all, not including the wheel. The wheel is to be 22 ft. dia., and the dip 18 in. The paddles are to be fixed. The boat's extreme beam is to be 36 ft., and the draught, 2 ft. She is to have a deck house extending 146 ft. forward from the stern. There are to be three decks, main, berth, and hurricane. From the main to the berth deck and from the berth to the hurricane deck, in the waist, there will be 7 ft. 'tween decks. The hurricane deck extends forward only 142 ft. from the stern. There will be a balanced rudder, which will probably be of the usual river type, with 3 blades.

The boilers are to sit on the main deck under the extreme forward end of the deck house, to balance the weight of the engines, which are to be located as far aft as possible. The plans call for two locomotive marine boilers, to carry 160 lbs. steam pressure, each boiler to be 64 inches dia. and 24 ft. long over the smoke boxes. They are to be fitted with steam and mud drums, and with grates to burn either coal or wood. Each boiler is to have 29 1-4 ft. of grate surface and 1,400 sq. ft. of heating surface. The boilers are to be placed side by side, with their axes fore and aft. There is to be one smokestack, 30 ft. high from the grates.

The designs include two tandem compound engines; Each H. P. cylinder 16 in. dia.; and each L. P. cylinder 28 in., with 84 in. stroke. The engines are to be on the main deck. There is to be an engineers' office, 12 ft. by 8 ft. in the forward end of the engine room, amidships.

The auxiliaries are one steam capstan, one steam steering engine, and a complete electric light plant, including a searchlight.

The armament will consist of two 1-pounder Hotckiss guns, one on each side of the main deck just forward of the deck house.

There will be a pilot house on the hurricane deck, at its forward end, with the steam steering engine on the berth deck directly under the pilot house. The remaining space on the berth deck forward of the smokestack will be occupied by the pantries, galleys, lamp rooms, and carpenter shop. On the berth deck, just abaft the smokestack there will be the ward room, officers' state rooms, armory, and medicine locker. Next aft will be the captain's cabin, and then the crew's quarters, which will be a space 46 ft. long, extending from the after bulkhead of the cabin to 20 ft. forward of the stern. The remaining space at the after end of the berth deck will be used for water closets and bath rooms.

The complement of the vessel will be three officers, of whom one will be an engineer, and thirty men. It is reported at the Treasury Department in Washington that there have already been about thirty applications by officers of the Revenue Cutter Service for duty on this boat.

Congress appropriated $40,000 to pay for this vessel. Wm. H. Birch & Co., of San Francisco,

offered to build and equip her for $32,650, and secured the contract.

Shipbuilding Returns for the U. S.

The following is the official list of sailing and steam vessels built in the United States and recorded by the Bureau of Navigation, Treasury Department, during the quarter ending March 31, 1898:

A summary shows the total number of sail to be forty-seven, of 4,177 gross tons, and of steam

Where built.	Wood.				Steel.			
	Sail.		Steam.		Sail.		Steam.	
	No.	Gross.	No.	Gross.	No.	Gross.	No.	Gross.
Atlantic & Gulf.	39	3,828	27	1,993	..	....	6	2,400
Pacific.....	8	349	10	1,881	..	....	..	....
Great Lakes....	..	....	1	73	..	....	..	....
Western Rivers.	..	....	20	2,440	..	....	..	....
								....
Total....	47	4,177	58	6,387	..	....	6	2,400

sixty-four, of 8,787 gross tons, or a grand total of 111 vessels of 12,964 gross tons. The grand total for the quarter ending December 31, 1897, was 185 vessels of 18,389 gross tons.

U. S. S. Michigan on the Great Lakes.

An appropriation of $260,000 in the Navy estimates for a war vessel to replace the "Michigan" on the Great Lakes calls attention to that famous old ship. She is a side-wheel iron vessel, the oldest in the Navy, and undoubtedly one of the oldest iron steam vessels in active service in any waters. She is classed as a special service vessel and is armed with four 30-pounder breech loading rifles, three 3-in. breech loading howitzers, and two Gatling guns. Her dimensions are: Length, 167 ft. 6 in.; beam, 27 ft. 1 in.; depth, 12 ft. 9 in., and displacement 685 tons. The hull plans were drawn about the year 1841 by Naval Constructor Samuel Hartt, and those for the machinery by C. W. Copeland. Material for the hull was rolled at Pittsburg and transported to Erie, Pa., where she was launched in 1843, and in the following year went on her first cruise. The original engines, which are still in the boat, are of the inclined type, with cylinders 36 in. dia. by 96 in. stroke. The wheels, as designed, were 21 ft. 10 in. dia. and 7 ft. 6 in. wide, with a dip of 3 ft. The original boilers were of the flue type with 1,620 ft. of heating surface, and furnishing steam at 15 lbs. pressure. The coal consumption was about 1,400 lbs. an hour and the rate of evaporation about 5 pounds of water per pound of coal. These boilers were taken out several years ago and more efficient generators substituted. The bunker capacity is about 120 tons, anthracite coal being used. The speed of the vessel is only 10 knots. For all practical naval purposes she is, of course, out of date, but nevertheless as an example of what American shipbuilders could do, half a century ago, she is a notable exhibit.

U. S. IRON GUNBOAT MICHIGAN ON THE GREAT LAKES.

LIST OF VESSELS RECENTLY PURCHASED OR REQUISITIONED BY THE NAVY.

On account of the widespread interest taken in the auxiliary vessels recently acquired by the Navy we herewith publish a reference table. This gives the new name of each vessel, with her general characteristics and notes of armament. It is not possible, of course, to make this complete, or as exact in details as would be desirable. This is chiefly because the Government, in the present emergency, has given power to various officers to purchase vessels upon their own judgment. Owing also to the scarcity of naval officers for shore duty the Navy Department has dispensed, as far as possible, with detailed reports from shore stations, and so in many cases there is little information available about vessels purchased, except their names and class. Even as we go to press, too late to tabulate, the purchase of additional vessels is reported. This table, however, is based on official information from the Department, and filled out from other sources.

(See pages 14 and 15.)

WARSHIPS AND AUXILIARY VESSELS RECENTLY ACQUIRED BY THE UNITED STATES NAVY BY PURCHASE, CHARTER OR TRANSFER.

Old Name.	Old Class.	Length. Ft. In.	Breadth. Ft. In.	Depth. Ft. In.	Draught. Ft. In.	Displacement. Tons.	Propulsion.	Horse Power.	Speed. Knots.	Rig.	Where Built
Abrouill	Protect'd cruiser	330	43 9	25	16 10	3,450	Twin screws	7,500	20	2 military masts	Sir W. G. Armstrong, Whitworth & Co., Elswick, Newcastle-on-Tyne
Agusa*	Steel yacht	264	31 6	20 6	.....	1,230 T. Y. M.	Single screw	2,500	16.25	.....	Scott & Co., Greenock
Alice	Steam lighter	.....	.....	.....	.....	260.02 gross	.....	....	....	.....	Rockyhill, Conn
Alicia	Yacht	160	22	13	11	425	Single screw	....	18	Schooner	Harlan & Hollingsworth
Almy	"	155 6	24	14	11 6	434	" "	900	15.5	"	" "
Amazonas	Protect'd cruiser	330	43 9	25	16 10	3,450	Twin screws	7,500	20	2 military masts	Sir W. G. Armstrong, Whitworth & Co., Elswick, Newcastle-on-Tyne
Armeria	Lighth'se tender	212 ft. over all	34	17	12 6	.....	" "	200 nominal	12	2-masted sch'ner	Camden, N. J.
Atlas	Ocean tug	130	25 6	14 6	12 6	462	.....	650	13	Schooner	Harlan & Hollingsworth
Calumet	Rev.cut'r, 2d rate	94 6	20 6	10 3	8 8	123 R. T.	Single screw	500	13	Harbor tug	Buffalo, N. Y.
Columbia	Yacht	180	23	14 3	12	630	" "	1,800	18	Schooner	Wm. Cramp & Sons
Corwin	Revenue cutter	145 6	23	.....	11 5	213 registered	" "	350	10	"	Portland, Ore.
Creole	Coast liner	375	44	32 6	.....	6,000 loaded	" "	3,500	....	.....	Newport News S. B. & D. D. Co.
De Witt C. Ivins	Tug	97	21	11	8	156	.....	400	7	.....	Neafie & Levy
Diogenes	Gunboat	250	35	21 9	10	1,800	Twin screws	....	16	Schooner	Thames Iron Works
Edward Luckenbach	Ocean tug	88 6	21 6	10 6	9 3	227	Single screw	500 nominal	11	"	John Dialogue
El Norte	Coast.freightst'r	350 6	48	23 11	22	6,000 to 8,000	" "	8,800	....	Steamship	Newport News S. B. & D. D. Co.
El Rio	" "	390 6	46 10	23 11	22	" "	" "	3,600	17	"	" " " "
El Sol	" "	390 7	46 10	31 6	.....	" "	" "	3,800	....	"	Wm. Cramp & Sons
El Sud	" "	380	48	39 9	.....	" "	" "	3,600	....	"	Newport News S. B. & D. D. Co.
El Toro	Tug	90	19	10 9	9	187	" "	250	10	"	" " " "
Grant	Revenue cutter	163	25	11.4	9 6	263 registered	Screw	420	10	.....	Wilmington, Del.
Guthrie	Rev.cut'r, 3d rate	87	17	8 5	8 7	98 gross	Single screw	225	12	Harbor tug	Baltimore, Md.
Hamilton	Rev.cut'r, 2d rate	144 ft. over all	23	11 10	9 7	250	" "	450	12	.....	Buffalo, N. Y.
Hermione	Yacht	145	22 6	13	11	375	" "	1,000	14.5	Schooner	Fleming & Ferguson, Paisley, Scotl'd
Hudson	Rev.cut'r, 3d rate	96 6	18 4	9 2½	9	174	" "	525	13.5	Harbor tug	Camden, N. J.
Josephine	Yacht	225	25	14	14	800	" "	1,000	12.5	.....	Lewis Nixon
Lebanon	Collier	246	37 5	22 5	.....	3,500 loaded	" "	1,000	....	Schooner	Wm. Cramp & Sons
Mangrove	Lighth'se tender	164 ft. over all, 159 ft. between perps.	30	11 10	8	392 gross	Twin screws	650	9	"	Lewis Nixon
Manning	Rev.cut'r, 1st rate	205	32	17	10 10	900	Single screw	2,000	16	Brigantine	East Boston, Mass.
Maple	Lighth'se tender	164 ft. over all, 155 ft. between perps.	30	11 10	.....	392.06 gross	Twin screws	650 nominal	9	2-masted sch'ner	S. L. Moore & Sons, Elizabeth, N. J.
Mayflower	Yacht	275	36 6	30 ft. to b'ge deck	17 2½	2,690	" "	4,600	16.75	Brigantine	Clydebank, Scotland.
Mayflower	Lighth'se tender	164	30	11 10	8	392.06 gross	" "	650	9	2-masted sch'ner	Bath Iron Works
McCulloch	R'v.cut,comp'site	219	33 4	17 10	14	1,280	Single screw	2,300	17.23	3-masted sch'ner	Cramps, Philadelphia, Pa.
Merrimac‡‡	Freighter	330	44	29	.....	2,556 net	" "	280	....	.....	C. L. Swan & Hunter, Newcastle
Morrill	Rev.cut'r, 2d rate	145 3	24	12 3	8 6	322	" "	500	12	Schooner	Camden, N. J.
Nanshan¶	Emigrant and cargo steamship	285	39 1	24 ft. unloaded	Light	3,400 deadw'ght	" "	....	13	"	Grangemouth Dock Yard Co.
Niagara	Passenger st'mer	274	38	25	19 6	5,221	" "	1,600	12	"	J. Roach & Son
Nictheroy§	Dynamite cruiser	380	48	.....	22	7,080	" "	4,000	18	.....	Newport News S. B. & D. D. Co.
P. H. Wise	Tug	84	19	9	8	155	" "	290	10	.....	Neafie & Levy
Paoli††	"	125 5	26	14 8	.....	330.71 gross	" "	660 nominal	....	Steamship	Chas. K. Hillman, Philadelphia
Perry	Revenue cutter	165	25	11 2	.....	282 gross	" "	400	11	Schooner	Buffalo, N. Y.
R. W. Wilmot	Tug	156 8	28	17	.....	.....	" "	2,000	....	"	F. W. Wheeler & Co., West Bay City
Rush	Revenue cutter	175	26	15	12 6	300 gross	" "	550	10.5	.....	Port Blakely, Wash.
Saturn	Salvage steamer	295 ft. over all	40	26 2	22 loaded	4,500 loaded	" "	1,300	12.5	Schooner	Harlan & Hollingsworth
Sovereign	Yacht	250 ft. 6 in. over all, 210 ft. 6 in bet. perps.	28 1	16 9	11 6	850	Twin screws	2,800	17.85	.....	Hull, John N. Robins; engines, W. & A. Fletcher
Sterling	Freighter	274	37	23 2	.....	5,663 loaded	Single screw	200	11	Schooner	Duncan & Co., Pt. Glasgow, Scotland
St. Louis	Transatl'tic liner	535.5	63	50.4	.....	11,629	Twin screws	18,000	20.87	2 pole	Wm. Cramp & Sons
St. Paul	" "	535.5	63	50.4	.....	11,629	" "	20,000	21.08	2 pole	" "
W. A. Luckenbach	Ocean tug	199 3	25	14 8	12	441	Single screw	750	12	Schooner	John Dialogue
Windom	Rev.cut'r, 1st rate	170 8	27	13 5	8 3	550	Twin screws	810	14	2 pole masts	Dubuque, Iowa
Winthrop	Ocean tug	125	26	15	14	571	Single screw	....	14	Schooner	Chas. K. Hillman & Co.
Woodbury	Rev.cut'r, 2d rate	146 6	28 6	11	11	330 gross	" "	500	11	"	Philadelphia
Zafiro¶	Cargo & pass. st'r	220	31 10	21 3	.....	1,100 gross	" "	200	12.5	.....	Hall, Russel & Co., Aberdeen
Unnamed	Torp'do b't, 1st cl.	152 (?)	.....	.....	.....	140 (?)	.....	2,500	25	.....	Schichau Elbing, Germany
Unnamed	Torpedo boat	61	9	.....	2 6	46	Single screw	....	17	.....	Yarrow

WARSHIPS AND AUXILIARY VESSELS RECENTLY ACQUIRED BY THE UNITED STATES NAVY BY PURCHASE, CHARTER OR TRANSFER—(Continued).

Old Name.	Date of Build'g	Hailing Port.	Name of Former Owner.	New Name.	New Class.	Commanding Officer.	Armament.	Complement. Officers.	Men.
Abrouill	1897	Brazilian Navy	Republic of Brazil	Albany	Protect'd cruiser	Not detailed	6 6-in. r. f., 4 4.7-in. r. f., 10 6-pdrs., 4 1-pdrs., 4 Maxims, 2 field guns	Not in Commission	
Ægusa*	1897	Palermo	Ignazio Florio	.....	Despatch boat	.....	.....	.....	
Alice	1882	Hartford, Conn.	.....	Alice	Supply boat	.....	.....	.....	
Alicia	1890	New York	H. M. Flagler	Hornet	Auxiliary gunb't	Lt. James M. Helm	1 6 pdr., 2 1-pdrs.	5	51
Almy	1890	"	F. Gallatin	Eagle	" "	Lt. Wm. H. H. South'rland	4 6-pdrs., 2 6-mm. Colts	5	60
Amazonas	1896	Brazilian Navy	Republic of Brazil	New Orleans	Protect'd cruiser	Capt. W. M. Folger	6 6-in. r. f., 4 4.7-in. r. f., 10 6-pdrs., 4 1-pdrs., 4 Maxims, 2 field guns	300 officers and men	
Armeria	1890	.....	United States	Armeria	.....	.....	.....	6	—
Atlas	1896	New York	Standard Oil Co.	Wompatuck	Auxiliary gunb't	Lt. C. W. Jungen	1 3-pdr., 1 Gatling	1	25
Calumet	1894	U. S. R. C. S.	United States	Calumet	Gunboat	.....	1 gun †	2	9 †
Columbia	1893	New York	J. Harvey Ladew	Wasp	Auxiliary gunb't	Lt. A. Ward	4 6-pdrs., 2 6-mm. Colts	5	51
Corwin	1876	U. S. R. C. S.	United States	Corwin	Gunboat	.....	3 guns †	8	32 †
Creole	1896	New York	Cromwell Line	Solace	Hospital ship	Comdr. A. Dunlop	.....	5	—
De Witt C. Ivins	1897	"	Moran Towing Co.	Nezinscot	Water boat	Mate Cleveland	1 6-pdr., 1 Colt	1	12
Diogenes	1883	.....	Thames Iron Works, London, Eng.	Topeka	Gunboat	Lt. Com. W. C. Cowles	2 Long Toms, 1 stern chaser, 4 Maxims	.....	
Edward Luckenbach	1896	New York	L. Luckenbach	Tecumseh	Auxiliary gunb't	Lt. J. G. Evans	1 1-pdr., 1 Gatling	1	12
El Norte	1892	"	Morgan Line	Yankee	Auxiliary cruiser	Comdr. W. H. Brownson	10 6-in., 6 6-pdrs.	N. Y. Naval Militia	
El Rio	1892	"	" "	Prairie	" "	Comdr. C. J. Train	8 6-in., 2 5-in. r. f., 6 6-pdrs.	Mass. Naval Militia	
El Sol	1890	"	" "	Yosemite	" "	Comdr. W. H. Emory	10 5-in. r. f., 6 6-pdrs.	Mich. Naval Militia	
El Sud	1892	"	" "	Dixie	" "	Comdr. C. H. Davis	" " "	Md. Naval Militia	
El Toro	1891	"	" "	Algonquin	Auxiliary gunb't	Ensign W. S. Crossley	1 6-pdr., 1 6-mm. Colt	1	12
Grant	1871	U. S. R. C. S.	United States	Grant	Gunboat	.....	4 guns †	.....	
Guthrie	1895	"	" "	Guthrie	"	.....	.....	2	8 †
Hamilton	1871	"	" "	Hamilton	"	.....	1 gun †	7	32 †
Hermione	1891	Boston	H. L. Pierce	Hawk	Auxiliary gunb't	Lt. J. Hood	2 6-pdrs., 2 6-mm. Colts	5	42
Hudson	1893	U. S. R. C. S.	United States	Hudson	Gunboat	.....	1 gun †	2	9 †
Josephine	1896	Philadelphia	P. A. B. & G. D. Widener	Vixen	Auxiliary gunb't	Lt. A. Sharp	.....	.....	
Lebanon	1894	"	Philadelphia & Reading R. R.	Lebanon	Collier	Comdr. Force	.....	5	—
Mangrove	....	United States	United States	Mangrove	Auxiliary gunb't	Lt. Comdr. Wm. Everett	.....	4	—
Manning	1897	U. S. R. C. S.	" "	Manning	Gunboat	.....	1 gun †	7	40 †
Maple	1892	"	" "	Maple	Auxiliary gunb't	Lt Comdr. W. Kellogg	.....	4	—
Mayflower	1897	New York	Estate of Ogden Goelet	Mayflower	Torpedo gunboat	Comdr. M. R. S. Mackenzie	2 5-in. r. f., 12 6-pdrs., 2 torpedo tubes, 2 6-mm. Colts	9	152
Mayflower	1897	.....	United States	Suwanee	Auxiliary gunb't	.....	.....	.....	
McCulloch	1897	U. S. R. C. S.	" "	McCulloch	Gunboat	.....	4 guns †	8	45 †
Merrimac ‡‡	1894	New York	T. Hogan & Sons	Merrimac	Collier	Comdr. J. M. Miller	.....	.....	
Morrill	1889	U. S. R. C. S.	United States	Morrill	Gunboat	.....	1 gun †	7	32 †
Nanshan ¶	1895	London	T. W. Richardson, London	Nanshan	Collier	.....	.....	.....	
Niagara	1877	New York	New York & Cuba Mail S. S. Co.	Niagara	"	.....	2 6-pdrs.	5	48
Nichtheroy §	1893	Brazilian Navy	Republic of Brazil	Buffalo	Dynamite cruiser	.....	1 15-in. pneumat. dynam. gun, 14.7 & 2 3.9 in. r. f., 8 6 & 10 1 pdrs., 4 torpedo tubes	.....	
P. H. Wise	1892	New York	Moran Towing Co.	Sioux	Auxiliary gunb't	Ensign W. R. Gherardi	1 6-pdr., 1 Colt	1	12
Paoli ††	1895	Fall River, Mass	Staples Coal Co.	.....	.....	.....	.....	.....	
Perry	1884	U. S. R. C. S.	United States	Perry	Gunboat	.....	2 guns †	7	32 †
R. W. Wilmot	1897	New Orleans	W. G. Wilmot, New Orleans	Potomac	.....	Lt. Blow	.....	.....	
Rush	1885	U. S. R. C. S.	United States	Rush	Gunboat	.....	3 guns †	8	32
Saturn	1890	Boston	Boston Towboat Co.	Saturn	Collier	.....	.....	.....	
Sovereign	1896	New York	M. C. D. Borden	Scorpion	Auxiliary gunb't	Lt. Comdr. Marix	4 5-in. r. f., 6 6-pdrs., 4 6-mm. Colts	6	—
Sterling	1881	"	C. A. Campbell & Co.	Sterling	Collier	.....	2 6-pdrs.	5	44
St. Louis	1895	"	International Navigation Co.	St. Louis	Auxiliary cruiser	Capt. F. R. Goodrich	Proposed 18-in. b. l. r., 5 5-in. q. f., 10 9-in. smooth bores, — 6-pdrs.	.....	
St. Paul	1895	"	" " "	St. Paul	" "	Capt. C. D. Sigsbee		.....	
W. A. Luckenbach	1893	"	L. Luckenbach	Uncas	Auxiliary gunb't	Lt. F. R. Brainard	1 1-pdr., 1 Gatling	1	12
Windom	1896	U. S. R. C. S.	United States	Windom	Gunboat	.....	3 guns †	7	37 †
Winthrop	1896	Taunton	Staples Coal Co.	Osceola	Auxiliary gunb't	Lt. J. L. Purcell	1 3-pdr., 1 Gatling	1	12
Woodbury	1864	U. S. R. C. S.	United States	Woodbury	Gunboat	.....	2 guns †	7	32 †
Zafiro ¶	1884	Hong Kong	China & Manila S. S. Co.	.....	Armed transport	.....	.....	.....	
Unnamed	....	.....	.....	Somers	Torpedo boat	....	2 torpedo tubes	Not in Commission	
Unnamed	....	.....	Yarrow	Manly	Despatch boat	.....	2 Hotchkiss r. f., 1 torpedo tube	.....	

* Bought in Italy. † These figures are for the Revenue Cutter Service. Corresponding ones for the Navy have not yet been determined. ¶ Reported bought by Commodore Dewey, on the Asiatic Station. § Originally the Morgan liner El Cid. †† Will be purchased only in case of war. ‡‡ Formerly Norwegian steamer Solveig.

REPORT OF THE "MAINE" NAVAL COURT OF INQUIRY.

A SUBMARINE MINE CAUSED THE PRIMARY EXPLOSION.

Finding of the Court Containing this Conclusion—Lengthy Extracts from the Testimony in the Original Text—Reproduction of Many Official Views and Drawings of the Wreck.

In this issue we are able to give to our readers excerpts from the official report of the Naval Court of Inquiry upon the destruction of the battleship Maine, February 15 last. This report formed part of a recent message of the President to Congress, and was, of course, discussed in its political aspects in the daily press, in which, however, technical details were omitted. We also reproduce all the engravings and drawings of importance which accompany the report. With the aid of these and the sectional views of the vessel, published in our March issue, our readers can intelligently follow the evidence and findings. It would not be possible, of course, in the limits of a periodical, to reprint the entire report, nor indeed would it be desirable to do so, for of necessity much of the matter contained in it is merely repetition, with such differences as the personal observation of many individuals would account for. All the salient points, however, are covered. As far as possible we use the original wording of the report, printing these extracts in smaller type, so that they can be readily distinguished.

The board, as our readers are aware, was composed of the following naval line officers: Captain William T. Sampson, president; Captain French E. Chadwick and Lieutenant-Commander William B. Potter, members, and Lieutenant-Commander Adolph Marix, judge advocate. The court commenced its sessions on the U. S. lighthouse tender Mangrove, at Havana, February 21, and remained there until March 15, after which it went to Key West, where the decision was reached March 21. In the words of the report this reads:

After full and mature consideration of all the testimony before it, the court finds as follows:

1. That the United States battleship *Maine* arrived in the harbor of Havana, Cuba, on the 25th day of January, 1898, and was taken to buoy No. 4, in from 5 1-2 to 6 fathoms of water by the regular government pilot.

The United States Consul-General at Havana had notified the authorities at that place, the previous evening, of the intended arrival of the *Maine*.

2. The state of discipline on board the *Maine* was excellent, and all orders and regulations in regard to the care and safety of the ship were strictly carried out.

All ammunition was stowed in accordance with prescribed instructions, and proper care was taken whenever ammunition was handled.

Nothing was stowed in any one of the magazines or shell rooms which was not permitted to be stowed there.

The magazines and shell rooms were always locked after having been opened, and after the destruction of the *Maine* the keys were found in their proper place in the captain's cabin, everything having been reported secure that evening at 8 p. m.

The temperatures of the magazines and shell rooms were taken daily and reported. The only magazine which had an undue amount of heat was the after 10-inch magazine, and that did not explode at the time the *Maine* was destroyed.

The torpedo war heads were all stowed in the after part of the ship, under the ward room, and neither caused nor participated in the destruction of the *Maine*.

The dry gun-cotton primers and detonators were stowed in the cabin aft, and remote from the scene of the explosion.

Waste was carefully looked after on board the *Maine* to obviate danger. Special orders in regard to this had been given by the commanding officer.

Varnishes, driers, alcohol and other combustibles of this nature were stowed on or above the main deck and could not have had anything to do with the destruction of the *Maine*.

The medical stores were stowed aft, under the ward room, and remote from the scene of the explosion.

No dangerous stores of any kind were stowed below in any of the other storerooms.

The coal bunkers were inspected daily. Of those bunkers adjacent to the forward magazines and shell rooms four were empty, namely: B3, B4, B5, B6. A15 had been in use that day, and A16 was full of New river coal. This coal had been carefully inspected before receiving it on board. The bunker in which it was stowed was accessible on three sides at all times, and the fourth side at this time on account of bunkers B4 and B6 being empty. This bunker, A16, had been inspected that day by the engineer officer on duty.

The fire alarms in the bunkers were in working order, and there had never been a case of spontaneous combustion of coal on board the *Maine*.

The two after boilers of the ship were in use at the time of the disaster, but for auxiliary purposes only, with a comparatively low pressure of steam, and being tended by a reliable watch.

These boilers could not have caused the explosion of the ship. The four forward boilers have since been found by the divers, and are in a fair condition.

On the night of the destruction of the *Maine* everything had been reported secure for the night at 8 p. m. by reliable persons, through the proper authorities, to the commanding officer. At the time the *Maine* was destroyed the ship was quiet, and, therefore, least liable to accident caused by movements from those on board.

EXPLOSIONS.

3. The destruction of the *Maine* occurred at 9:40 p. m. on the 15th day of February, 1898, in the harbor of Havana, Cuba, she being at the time moored to the same buoy to which she had been taken upon her arrival. There were two explosions of a distinctly different character, with a very short but distinct interval between them, and the forward part of the ship was lifted to a marked degree at the time of the first explosion. The first explosion was more in the nature of a report like that of a gun, while the second explosion was more open, prolonged, and of greater volume. This second explosion was, in the opinion of the court, caused by the partial explosion of two or more of the forward magazines of the *Maine*.

CONDITION OF THE WRECK.

4. The evidence bearing upon this, being principally obtained from divers, did not enable the court to form a definite conclusion as to the condition of the wreck, although it was established that the after part

of the ship was practically intact, and sank in that condition a very few minutes after the destruction of the forward part.

The following facts in regard to the forward part of the ship are, however, established by the testimony:

A portion of the port side of the protective deck, which extends from about frame 30 to about frame 41, was blown up, aft, and over to port. The main deck, from about frame 30 to about frame 41, was blown up, aft, and slightly over to starboard, folding the forward part of the middle superstructure over and on top of the after part.

This was, in the opinion of the court, caused by the partial explosion of two or more of the forward magazines of the *Maine*.

5. At frame 17 the outer shell of the ship, from a point 11 1-2 feet from the middle line of the ship, and 6 feet above the keel when in its normal position, has been forced up so as to be now about 4 feet above the surface of the water, therefore about 34 feet above where it would be had the ship sunk uninjured.

The outside bottom plating is bent into a reversed V shape (Λ) the after wing of which, about 15 feet broad and 32 feet in length (from frame 17 to frame 25), is doubled back upon itself against the continuation of the same plating, extending forward.

At frame 18 the vertical keel is broken in two, and the flat keel bent into an angle similar to the angle formed by the outside bottom plating. This break is now about 6 feet below the surface of the water, and about 30 feet above its normal position.

In the opinion of the court this effect could have been produced only by the explosion of a mine situated under the bottom of the ship at about frame 18 and somewhat on the port side of the ship.

6. The court finds that the loss of the *Maine* on the occasion named was not in any respect due to fault or negligence on the part of any of the officers or members of the crew of said vessel.

7. In the opinion of the court the *Maine* was destroyed by the explosion of a submarine mine, which caused the partial explosion of two or more of the forward magazines.

8. The court has been unable to obtain evidence fixing the responsibility for the destruction of the *Maine* upon any person or persons.

W. T. Sampson,
Captain, U. S. N., President.

A. Marix,
Lieut. Com. U. S. N., Judge-Advocate.

At the opening of the Naval Court of Inquiry, Captain Charles D. Sigsbee, commander of the "Maine," was the first witness called, and asked:

Q. When did you take command of the *Maine?*

A. On the 10th day of April, 1897.

Q. When did the *Maine* arrive at Havana the last time?

A. On the 24th day of January, 1898.

Q. About what time?

A. About half-past 9 in the morning.

Q. Do you know, or have you any reason to believe, that the authorities of Havana knew of the *Maine's* coming?

A. Yes; I understand that they were notified by the United States Consul-General.

Q. Upon your arrival, did you take a pilot?

A. I did; I took an official pilot sent off by the captain of the port of Havana.

Q. Did he berth the *Maine?*

A. He did.

Q. Where?

A. The berth is in the man-of-war anchorage off the Machina, or the Shears. It is to all appearances one of the regular mooring buoys of the place. My recollection is that the pilot said that it was buoy No. 4. Our bearings, taken soon after mooring, did not place it exactly according to the charted position of buoy No. 4, but no note was taken of this because it was assumed that the charted position might represent former positions, and the buoys might have been changed somewhat in the examinations of the moorings.

Q. Have you been to Havana before frequently or recently?

A. I was here about 1872, and again about 1878.

Q. Do you know if you were placed in the usual berth for men-of-war?

A. No. I can only state that by remarks I have heard since the explosion.

Q. State what you heard.

A. I have been informed, since the explosion on board the *Maine*, by Captain Stevens, who is temporarily in command of the steamer *City of Washington*, of the Ward Line of steamers, that he had never known in all his experience, which covers visits to Havana for five or six years, a man-of-war to be anchored at that buoy, and that he had rarely known merchant vessels to be anchored there, and that it was the least used buoy in the harbor.

Q. Will you please describe the surroundings when first moored to this buoy?

A. The Spanish man-of-war *Alfonso XII* was moored in the position now occupied by the *Fern*—about 250 yards to the northward and westward of the *Maine*. The German ship *Gniesenau* was anchored at the berth now occupied by the Spanish man-of-war *Segaspe*, which is about 400 yards about due north from the *Maine*. A day or two after the arrival of the *Maine* the German man-of-war *Charlotte* came in and was anchored about four or five hundred yards to the southward of the *Maine's* berth. Other vessels, merchant vessels, came and went, anchored and moored in localities more or less remote, from 200 yards upward.

Q. Will you please describe your surroundings at the time of the explosion?

A. It was a calm and still night. At the time of the accident the Spanish man-of-war *Alfonso XII* was at the berth, as before stated. The small Spanish dispatch boat *Segaspe* had come out, I think, the day before and taken the berth occupied by the Spanish man-of-war, the *Gniesenau* having left. The steamer *City of Washington* was anchored about two hundred yards to the southward and eastward of the *Maine's* stern, slightly on the port quarter. That is as much as I can give. Other vessels were remote, so far as my recollection goes.

Q. When did you coal before the last coaling?

A. We coaled at Key West within a week of the time of our arrival.

Q. How much coal did you take at that time, if you remember?

A. I think about one hundred and fifty tons.

Q. Was the coal regularly inspected?

A. My recollection is that it was. It was from the government coal pile, and we had the usual men on shore; and while I cannot now state specifically, it was our invariable custom on board the *Maine* to inspect all coal before it was brought on board.

Q. How much coal did you take in the last coaling previous to this, and where?

A. It was at Key West, and I think in the neighborhood of 300 tons.

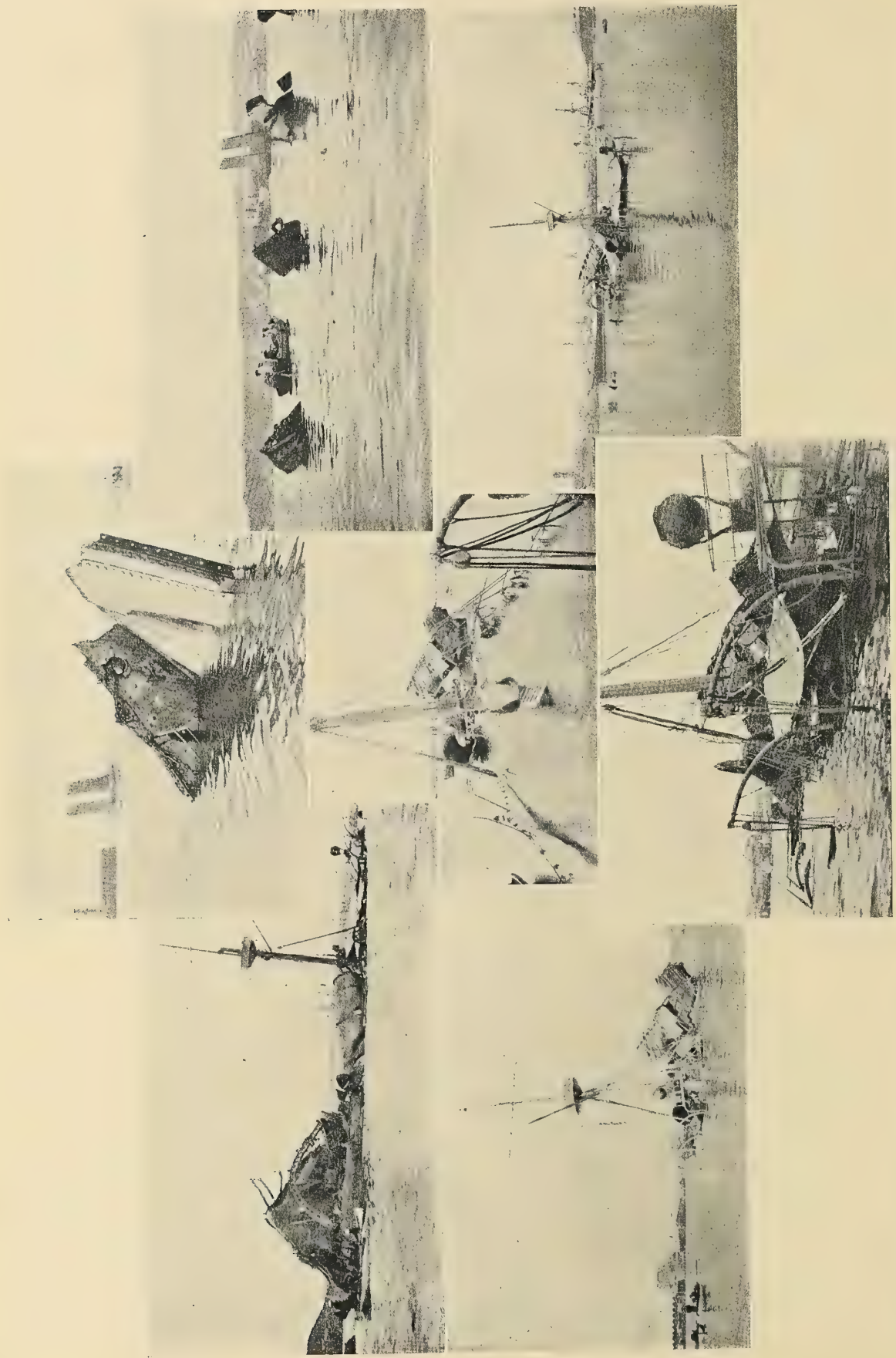
Q. Into what bunkers was the coal placed at these coalings?

A. Generally in the forward bunkers, because it was customary to use coal from the forward bunkers first. These bunkers naturally, therefore, were replenished with new coal.

Q. There is a peculiar bunker under the forward turret, abreast the 10-inch magazine. Do you know when that was last emptied?

A. I cannot personally recollect that particular bunker.

Q. Did you ever receive any report from the chief engineer of your ship that any coal had been too long in any bunker?



OFFICIAL PHOTOGRAPHS OF THE WRECK OF THE "MAINE" IN HAVANA HARBOR—REPRODUCED FROM THE REPORT OF THE COURT OF INQUIRY.

OFFICIAL PHOTOGRAPHS OF THE WRECK OF THE "MAINE" IN HAVANA HARBOR—REPRODUCED FROM THE REPORT OF THE COURT OF INQUIRY.

A. Never that I can recollect.

Q. Did the fire-alarms in the bunkers work?

A. They were sensitive. They worked occasionally when there was no undue heat in the bunkers, on which occasions we invariably examined the bunkers and got a report.

Q. Regarding inflammables and paints on board the *Maine*, were the regulations strictly carried out in regard to the stowage?

A. Strictly, so far as my knowledge and my orders were concerned. I was very particular on points of that kind. I was especially particular in my directions to the chief engineer concerning the disposition of waste which had been used. He had informed me that it was always kept in a covered metal bucket until thrown overboard with the ashes. He has since informed me that it was habitual to throw it overboard every day with the ashes.

Q. How often did you discharge ashes in Havana?

A. I cannot now recollect; but I remember giving certain directions in connection with hired lighters and not dumping in the harbor. The chief engineer was generally very solicitous about getting ashes out of the ship promptly.

Q. Where were ashes kept until discharged?

A. Those that I saw were dumped about the region of the bulkhead between the two fire rooms. There was a passage out of the forward part of the forward fire room which would have been blocked by ashes.

Q. Regarding paints and inflammables, was there not a paint room well forward below the berth deck?

A. The paint room was in what is called the eyes of the ship, just below the berth deck, the extreme forward compartment.

Q. What were the regulations in regard to that paint room? Was the painter allowed to stow any inflammables there?

A. He was not. The inflammables were stowed in chests aft, according to regulations, and when inflammables were in excess of our chest capacity they were allowed to be kept in the bathroom of the port or admiral's cabin.

Q. I believe Japan dryers, turpentine, and such were kept forward inside the superstructure. Am I not correct?

A. That is my recollection.

Q. Regarding the electric plant of the *Maine*, have you any reason to believe, from your observation of the lights or from any reports that may have been made to you, that there had been serious grounding?

A. None whatever; and there was no sudden flaring up of the lights before the explosion.

Q. No perceptible disturbance of the lights?

A. None whatever; there was a sudden and total eclipse.

Q. What were the regulations of the ship in regard to taking the temperature of the magazines, etc.?

A. There were no special regulations other than those that were regulations. The magazines were examined according to regulations, and reports made accordingly and sent to the Department. I always examined the temperature myself and conversed with the ordnance officer as to the effect of various temperatures on the contents of the magazines, and in his opinion, and my own, the temperatures were never near the danger point. I do not think there was any laxity in this direction. I cannot recollect any. When I joined the ship I found it was considered unnecessary to use slippers in the magazine, and I directed that they should be used.

Q. Do you recollect any work going on in the magazine or shell rooms on the day of the disaster?

A. My recollection is that the keys were called for that morning at quarters in the usual way. I cannot recollect any other call for the keys on that day.

Q. Were the keys properly returned after quarters?

A. Yes; so far as I can recollect. The regulation reports were made at 8 o'clock by the executive officer. The keys of all the shell rooms and magazines, and the spare keys, have been recovered by the diver in my stateroom, where they were always kept.

Q. At the time of the disaster what boilers were being used?

A. The two after boilers in the after fire room. More than one boiler was in use, for the reason that our hydraulic system was somewhat leaky.

Q. Please inform the court in a general way, giving any particulars you wish to give, in regard to your relations to the Spanish authorities and native authorities or people, from the time of the arrival of the *Maine* until the time of your disaster.

A. My relations with the officials were outwardly cordial, and I have no ground for assuming that they were not really cordial. The members of the autonomistic council of the government, however, seemed to have brought to the attention of the Navy Department the fact that I did not visit them. They made me no suggestions to visit them. From the letters and telegrams received from the Navy Department there seems to have been some embarrassment caused the government at Washington by the fact that I made them no visit. I took the ground to the department that it was unknown etiquette to call on the civil members of the colonial government other than the governor, but that I would have exceeded etiquette at any time on suggestion from the council. Without waiting for orders I made a visit afterwards. My visit was pleasantly received, and promptly returned by certain members of the council. They sent on board a large party of ladies a day or two afterwards. The president of the council, on board the *Maine*, made me a very cordial address, which I could not understand, and which was interpreted to me briefly. I replied briefly, expressing kind sentiments and a hope for the continuance of cordial relations between Spain and the United States. Fancying that some expression cordial to the colonial or autonomistic government might be expected of me, I evaded the point, and used only this expression: "I beg to express my admiration for the high purpose of your honorable body." My reply was afterwards printed in at least two papers in Havana, but the terms made me favor autonomistic government in the island. I am informed that the autonomistic government in Havana is unpopular among a large class of Spanish and Cuban residents. I have no means of knowing whether my apparent interference in the political concerns of the island had any relation to the destruction of the *Maine*.

Q. Was there ever any demonstration of animosity by people afloat?

A. Never on shore, so far as I am informed; but afloat there was a demonstration. It was the first Sunday after our arrival, on board a ferryboat, densely crowded with people, both civil and military, who were returning to Havana from a bull fight in Regla. The demonstration consisted of yells, whistles, and apparently derisive calls emanating from about thirty or forty people at most. It was not general.

Q. During the stay of the *Maine* at Havana did you take other than the ordinary precautions which are usually taken on every man-of-war for her protection?

A. I did.

Q. Please state them fully.

A. I had sentries on the forecastle and poop, quartermaster and signal boy on the bridge, signal boy on the poop; the corporal of the guard especially instructed to look out for the port gangway; the officer of the deck and quartermaster especially instructed to look out for the starboard gangway; a quarter watch was kept on deck all night; sentries' cartridge boxes were filled, their arms kept loaded, a number of rounds of rapid-firing ammunition kept in the pilot house, and, in the spare captain's pantry, under the after superstructure, additional charges of shell close at hand for the secondary battery; steam kept up in two boilers instead of one; especial instructions given to watch carefully all the hydraulic gear and

report defects; the officer of the deck charged with the necessity for making detailed reports to me, even in minor matter. I had personally instructed the master at arms and the orderly sergeant to keep a careful eye on everybody that came on board, and to charge all their subordinates to the same purpose. I instructed them that, when any persons came on board to go below, they were to go with them, and carefully observe any packages that might be held, on the supposition that dynamite or other high explosive might be employed; and to afterwards inspect the routes these people had taken, and never to lose sight of the importance of my order. I further instructed the marine officer to make at least two visits during the night to the posts of the vessel. The whole purport of my orders and directions was that we should consider the *Maine* in a position demanding extreme vigilance. Doubtless I gave many other detailed orders of a minor character that I cannot now recall.

Q. Regarding strangers being in the ship, at what time were they compelled to leave the ship?

A. I think Lieutenant-Commander Wainwright was rather severe on desultory visitors. Very few visited the ship, except people of the highest social standing in the city. They came commonly from 2 to say 5 o'clock. They were always accompanied about the ship by officers, and of course under the supervisory orders of the master at arms and sergeant of marines. People were allowed to visit the ship from about 10 to 12, and about 1 to 4. I think there were but two visits of Spanish military officers. Once, about two weeks ago, a party of five or six Spanish officers came on board during my absence. They were reported to me as having been constrained, and not desirous to accept much courtesy. They accepted no refreshments, but I afterward learned that it is a Spanish custom not to accept refreshments unless they are at hand at the time the offer is made. On another occasion, about the same time, a Spanish officer came off with his wife. He made a visit to my cabin, and was shown about the ship by an officer under my direction. I invited Spanish officers to visit the ship; in fact, I made considerable effort to get them on board socially in order to show good will according to the spirit of the *Maine's* visit to Havana; but, with the exceptions noted, no military officer of Spain visited the ship socially, so far as I can remember. I know that the purser of the *Alfonso XII* made a social visit; but I cannot recollect a purely social visit from other Spanish officers. The wardroom officers of the *Maine*, perhaps, have further information on this point.

Q. Among the precautions which you took was the fact of having extra lookouts on the deck. Was there ever any report of any unauthorized boats attempting to approach the ship and being ordered off?

A. Never, to my knowledge.

Q. On the night of the disaster, were all your extra precautions in force? I mean, in regard to quarter watches?

A. I assume that they were; they were never rescinded, and up to the night of the explosion, as far as my observation could go, my knowledge is that they were carried out. I was especially impressed during the whole visit here by the prompt tendency of the sentries to report any infractions of orders on the part of the crew.

Q. At the time of the accident, do you know what boats were down, and where?

A. I assume that one of the cutters was down, and one of the steam launches. I think the first steam launch was down. The steam launch, I have since been informed, was riding at the starboard boom, and that one of her crew was saved. He is now in the hospital at Havana.

Q. What kind of a night was it at the time of the explosion?

A. It was a very quiet and warm night, and I remember distinctly that the echoes of the bugle at tattoo were singularly distinct and pleasant. A little rain fell after the explosion, which may have been precipitated by the concussion of the explosion.

Q. Was it a dry night?

A. There were stars, but I think it was somewhat overcast. I think I saw several stars after the accident, but it was somewhat overcast according to my recollection.

Q. How was the *Maine* heading at the time of the explosion?

A. Approximately northwest. She pointed toward the shears—somewhat to the right of the shears, near the admiral's residence.

Q. Where were you at the time?

A. I was writing at my port-cabin table, after side. I was dressed.

Q. Please give your experience in full.

A. I was just closing a letter to my family when I felt the crash of the explosion. It was a bursting, rending, and crashing sound or roar of immense volume, largely metallic in its character. It was succeeded by a metallic sound—probably of falling débris—a trembling and lurching motion of the vessel, then an impression of subsidence, attended by an eclipse of the electric lights and intense darkness within the cabin. I knew immediately that the *Maine* had been blown up and that she was sinking. I hurried to the starboard cabin ports, thinking it might be necessary for me to make my exit in that way. Upon looking out I decided that I could go by the passage leading to the superstructure. I therefore took the latter route, feeling my way along and steadying myself by the bulkheads. The superstructure was filled with smoke, and it was dark. Nearing the outer entrance I met Private Anthony, the orderly at the cabin door at the time. He ran into me and, as I remember, apologized in some fashion, and reported to me that the ship had been blown up and was sinking.

I reached the quarter-deck, asked a few questions of those standing about me—Lieutenant-Commander Wainwright, I think, for one—then I asked the orderly for the time. He said that the exact time of the explosion was 9:40 p. m. I proceeded to the poop deck, stood on the side rail, and held on to the main rigging in order to see over the poop awning, which was baggy and covered with débris; also in order that I might observe details in the black mass ahead. I directed the executive officer to post sentries all around the ship, but soon saw that there were no marines available, and no place forward to post them. Not being quite clear as to the condition of things forward, I next directed the forward magazine to be flooded if practicable, and about the same time shouted out myself for perfect silence everywhere. This was, I think, repeated by the executive officer. The surviving officers were about me at the time on the poop. I was informed that the forward magazine was already under water, and after inquiring about the after magazine was told that it was also under water, as shown by the condition below reported by those coming from the wardroom and steerage.

About this time fire broke out in the mass forward, over the central superstructure, and I inquired as to the spare ammunition in the captain's pantry. That region was found to be subsiding very fast. At this time I observed, among the shouts or noises apparently on shore, that faint cries were coming from the water, and I could see dimly white, floating bodies, which gave me a better knowledge of the real situation than anything else. I at once ordered all boats to be lowered, when it was reported that there were only two boats available, namely, the gig and whaleboat. Both were lowered and manned by officers and men, and by my direction they left the ship and assisted in saving the wounded jointly with other boats that had arrived on the scene from the Spanish man-of-war, from the steamer *City of Washington*, and from other sources. Later—I cannot state precisely how long—these two boats of the *Maine* returned to the starboard quarter alongside, and reported that

they had gathered in from the wreck all the wounded that could be found and had transferred them to the other boats—to the *Alfonso XII* or to the *City of Washington.*

The poop deck of the *Maine,* the highest point, was by that time level with the gig's gunwale while she was afloat in the water alongside. The fire amidships was burning more fiercely and the spare ammunition in the pilot house was exploding in detail. We had done everything that could be done so far as I could see. Lieutenant-Commander Wainwright whispered to me that he thought the 10-inch magazine forward had been thrown up into the burning mass, and might explode in time. I directed him then to get everybody into the boats over the stern, and this was done, although there was some little delay in curbing the extreme politeness of the officers, who wanted to help me into the boat. I directed them to go first, as a matter of course, and I followed and got into the gig. We proceeded to the steamer *City of Washington,* and on the way I shouted to the boats to leave the vicinity of the wreck, and that there might be an explosion. I got Mr. Sylvester Scovell to translate my desire to one or two boats which were at that time somewhat nearer the fire than we ourselves were.

Having succeeded in this, I went on board the *City of Washington,* where I found our wounded all below in the dining saloon on mattresses, covered up, and being carefully attended by the officers and crew of that vessel. Every attention that the resources of the vessel admitted was being rapidly brought into use. I then went on deck and observed the wreck for a few minutes, and gave directions to have a muster taken on board the *City of Washington* and other vessels, and sat down in the captain's cabin and dictated a telegram to the Navy Department. At this time various Spanish officers—civil, military, and naval—appeared on board, in their own behalf and in representative capacity, expressing sympathy and sorrow for the accident. The representatives of General Blanco and of the admiral of the station came on board, and the civil governor of the province was on board in person. I asked them to excuse me for a few minutes, until I completed my telegram to the Navy Department.

After finishing the telegram and putting it in the hands of a messenger to be taken on shore, I conversed for a few minutes with the various Spanish gentlemen around me, thanking them for the visit and their sympathy. I was asked by many of them the cause of the explosion, and I invariably answered that I must await further investigation. For a long time the rapid-fire ammunition continued to explode in detail. The number of the wounded was reported to me later. I have some difficulty in remembering figures. I think we found about 84 or 85 men that night who survived. It was also reported to me that the wounded on board Spanish vessels had been taken to the hospitals on shore, as were also the survivors who had reached the machina, in the neighborhood of the shears on shore. To keep a clear head for the emergency I turned in about 2 o'clock, getting little sleep that night, owing to the distressing groans of the wounded.

Q. By the time you reached the quarter-deck, were all the large explosions over?

A. So far as my experience is concerned there was simply one impression of an overwhelming explosion. I do not recollect details. I have already stated the explosions of minor character.

Q. But you yourself saw no large upshoot of flame?

A. When I came from the cabin, I was practically blinded for a few seconds. I thought only of the vessel, and took no note of the phenomena of explosion. It is probable that the explosive column had subsided wholly or practically by the time I reached the deck. I am not sure, because of the intense darkness.

Q. You state in your story that the *City of Washington* attended to the wounded. Did not the Spanish man-of-war also do the same?.

A. I am not very sure personally, but the reports were that they were doing all that was possible. There was no reference to me on the part of the Spanish officers for sending the wounded on shore. I assume and believe that they did everything in their power to care for the wounded, and have continued to do so most conscientiously ever since.

Q. How many were wounded; how many killed; and how many were saved not wounded?

A. I would have to refer to my figures for that, and they are not now at hand. The muster, I think, shows 101 saved, including the wounded, and 253 lost. Some of the wounded have since died. My duties have been too complex since the explosion to enable me to memorize all the figures.

Q. From your examination of the wreck, as far as you have been able to make, what magazines or shell rooms, if any, should you say were blown up?

A. From the appearance of things about the wreck it is extremely difficult to come to any conclusion. The center of the explosion appears to have been beneath and a little forward of the conning tower, and on the port side. The forward part of the superstructure has been thrown upward backward over the after part and toward the starboad side, indicating an explosion on the port side of the ship. In the region of the center or axis of explosion was the 6-inch reserve magazine, which contained very little powder—probably, I am informed, about 300 pounds. The 10-inch magazine is in the general region, but it is on the starboard side, under the forward turret, which is well out on the starboard side. Over the 10-inch magazine in the loading room of the turret, and in the adjoining passage, and well on the starboard side, were a number of 10-inch shell, permanently placed. There were also several additional shell in the loading room. It is difficult, therefore, to conceive that the explosion involved the 10-inch magazine, because of the location of the explosion, and because I have had no reports that any 10-inch shell were hurled into the air by the explosion. The violence of the explosion, although not its immediate locality, indicates that the 10-inch magazine may have been involved.

Q. Where was the 10-inch shell room?

A. The 10-inch shell room was abreast the 10-inch magazine on the port side. It opened on the port side of the vessel.

Q. Was it not between the reserve 6-inch and 10-inch magazines?

A. It was.

Q. Do you know the thickness of the bulkhead between those three divisions?

A. I cannot recollect. I should say that it was of ordinary metal, the thickness of a bulkhead of similar construction in other parts of the ship.

Q. Do you know what was between the coal bunker and the magazine?

A. I think nothing but the ordinary steel plate. It is so aft.

Q. Where was the small-arm ammunition locker forward, and what was in it?

A. We had received a new supply of ammunition, and this was kept forward of the thwartship armor bulkhead. I mean the small-arm and rapid-fire ammunition.

Q. Was there any smokeless powder?

A. There was no great gun smokeless powder ammunition. All the great gun ammunition was the ordinary brown powder.

Q. Was there not a 6-inch ammunition room forward of the small-arm ammunition rooms?

A. There was; supply for the forward 6-inch guns.

Q. On what side was the powder stowed in that one?

A. I have visited it, but I cannot now exactly recall

the exact position of the stowage. I know the powder chute is on the starboard side?

Q. Do you think that the forward 6-inch magazine blew up?

A. I do not think so. I cannot find reason to suppose so. One man at least was blown out of the forward superstructure into the water. It is more than probable that he would have been blown to atoms if the magazine had exploded.

Q. Where did you keep your gun-cotton?

A. Aft, under the cabin. The war heads were all stowed in that part of the ship which was not affected by the explosion. It was away aft.

Q. Where were the gun-cotton primers and detonators kept?

A. They were always kept in my cabin.

Q. Was any torpedo of the *Maine* fitted with its war head at the time of the explosion?

A. It was not. They were put in especially good condition, but none were fitted with war heads.

Q. Please state all the steps you have taken since the accident to ascertain its cause, and any results you may have obtained.

A. I have examined the wreck myself, conversed with other officers and men, and to some slight extent, in a categorical way, with the Spanish admiral. I have had a board of three officers make inquiries throughout the bay, but I have not yet received the reports from all the officers; nor have I had time to read the preliminary reports now in hand. I have not sent down any divers until this morning, not having had the necessary facilities. The best divers here are apparently in the employ of private parties, and since the Spanish authorities are very much averse to an investigation except officially, on the ground, as stated by the Spanish admiral, that the honor of Spain is involved, I have foreborne to examine the submarine portion of the wreck for the cause of the explosion until this morning. The divers of the fleet are now at work. I have had divers down in the cabin, and have recovered by that means the cipher code and magazine keys.

Q. What was the state or the condition of the *Maine* as far as discipline was concerned?

A. It was excellent. This is attested by the fact that the *Maine* was chosen for the duty on which she was engaged. She would not have been chosen had she been in any other than good discipline. The marine guard was in excellent condition. The medical reports from the medical department will show, I think, that about one man and one-quarter per diem were on the sick list during the past year. In the paymaster's department I think I am justified in saying that none of the reports of the paymaster to the Government at Washington were returned to the vessel for correction during my period of command. In the engineer's department the vessel was always ready and always responsive. I can recollect no letter from any source relating to the engineer's department which could be considered in the least of an adverse nature, except that the bureau once objected to a boiler being used in any degree as a tank. I think the punishment reports of the *Maine* are as small as those of any other vessel of the Navy in proportion to complement. They were uncommonly small. A quieter, better-natured, well-ordered, and apparently satisfied crew I have never known on board any vessel in which I have served.

Q. Have you any fault to find with the behavior of any officer or man at the time of the disaster?

A. None. I consider that the conduct of all was admirable. The behavior of the officers toward me personally and the prompt and responsive recognition of my authority was admirable, and instances of bravery are known both among the officers and crew in the direction of rescuing shipmates.

(The judge-advocate announced that at present he had no further questions to ask Captain Sigsbee.)

Examination by the COURT:

Q. What is the highest temperature you remember to have been reported in the forward magazines?

A. The highest temperature that I remember—and I think I can recall the figures—was 112°; but that was in the after magazines, where the temperatures were higher than in the forward magazines. I do not recollect the temperature in the forward magazines, because they were not so high as in the after magazine.

Q. Was any loose powder kept in the magazines, or was it all stowed in the usual air or water-tight cylinders, which each contains a charge?

A. I never permitted any to be kept loose, and do not believe that any was so kept.

Q. What was the status of the coal bunkers next to the forward magazines? Were they full, or had there been any coal used out?

A. All the bunkers were ventilated through air tubes, examined weekly by the chief engineer, and otherwise as was necessary, and they were connected electrically to the annunciator near my cabin door. The forward coal bunker on the port side was full, so I understand; the forward coal bunker on the starboard side adjoining the magazine has been reported to me as being one-half full, and it was in use at the time of the explosion.

The next witness was Lieutenant George F. M. Holman. Portion of his testimony is here given:

Q. What duty have you performed on board the *Maine* during that time?

A. The duty of navigator and ordnance officer.

Q. Did this duty also put you in charge of the electric plant?

A. Yes.

Q. Regarding the magazines of the *Maine*, what precautions do you know were taken for safety whenever the magazines were opened?

A. The usual precautions were taken with regard to all lights, if any were burning, and to stop smoking. The police, the master at arms, and others were always notified, and word sent, in fact, all over the ship. The galley was screened and the flag was hoisted in receiving ammunition on board, or putting it out. On all occasions, when magazines were opened, word was sent, as already said, all over the ship.

Q. What precautions were taken by the men in entering the magazines or shell rooms?

A. The question came up some time ago as to putting on the magazine shoes, that is, a short time after Captain Sigsbee took command. Prior to that time the order had not been enforced in regard to magazine shoes or slippers. Captain Sigsbee gave the order to make them wear their magazine shoes wher they went down.

Q. Were all other precautions taken described by regulations?

A. Yes; so far as I know.

Q. Please state whether any work had been going on in the magazine or shell rooms, or in the small-arm ammunition rooms, within a day or so of the explosion?

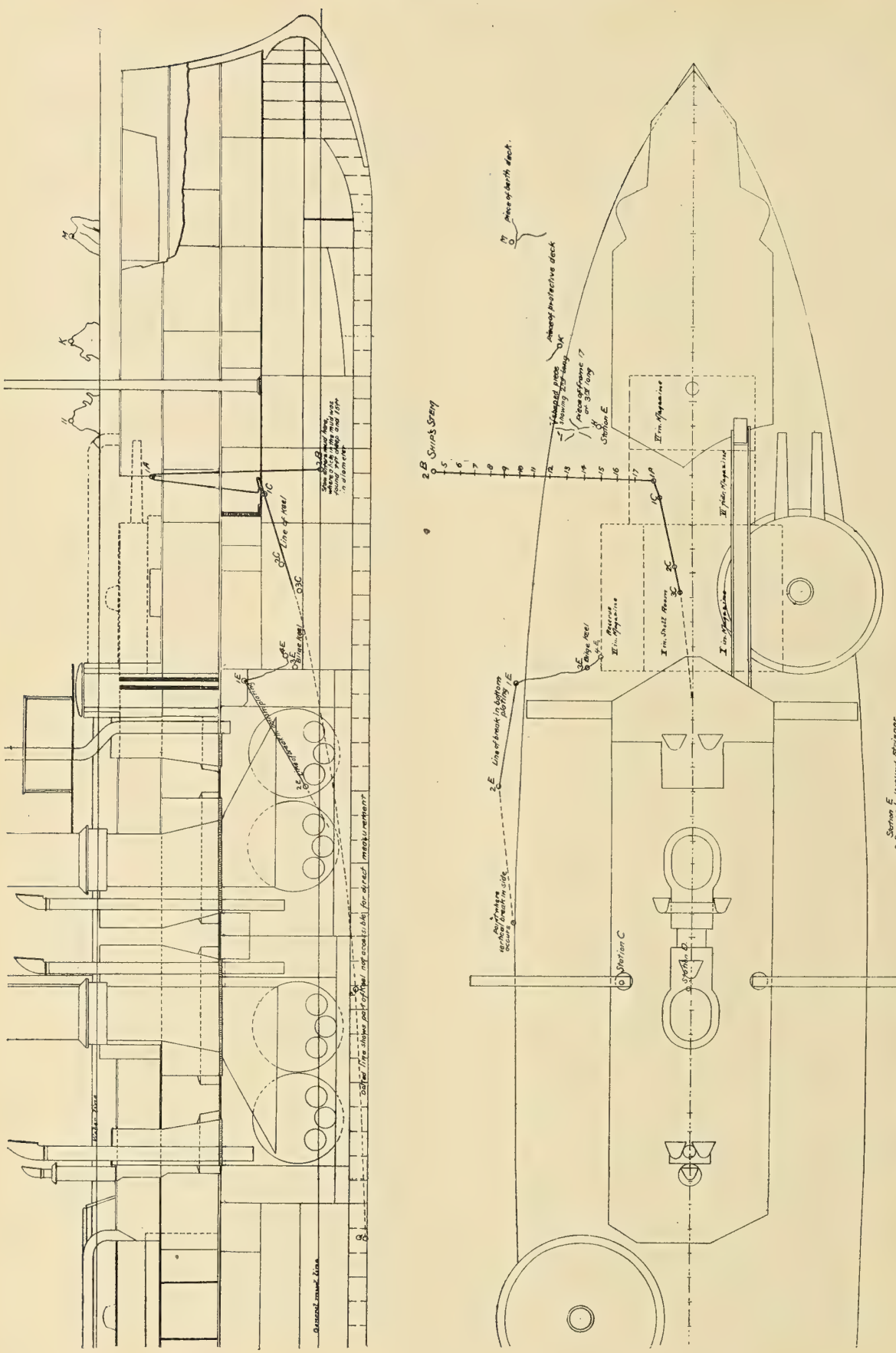
A. On Monday we had our usual drills, and part of it being a drill of the powder division at their stations. I do not know of any work going on around the magazines. I would, no doubt, have known if any had been undertaken.

Q. Please state to the court how the orders in regard to the taking of the temperatures of the magazines and shell rooms were carried out on board the *Maine*.

A. The temperature was taken daily of the magazines and shell rooms and ammunition rooms, and recorded in monthly reports to the Bureau.

Q. Was this fully carried out up to the time of the explosion?

A. I have no doubt that it was. I know of its having been carried out to within at least two or three days previous. I presume that it was carried out the remaining part of the time.



PROJECTION SHOWING PRESENT POSITION OF THE KEEL AND BOW OF THE "MAINE."—REPRODUCED FROM OFFICIAL REPORT.

Q. Who took this temperature?

A. The chief gunner's mate; previously the gunner.

Q. How high did the temperature reach during your experience on board the *Maine?*.

A. The hottest magazine was the 10-inch after magazine, where it reached as high as one hundred and ten in hot weather, remaining there for some time.

Q. Can you state to the court how much ammunition was stowed in the 6-inch reserve magazine which was on the port side of the ship abreast of the 10-inch shell room?

A. I think there were about 200 pounds of saluting powder in tanks. If there was any other powder there, it was of small amount. I am not sure.

Q. Were there any 6-inch charges stowed there?

A. I think not. We had room for all our 6-inch powder in the regular 6-inch magazines. I know of no 6-inch charges.

Q. How are the magazines and shell rooms on board the *Maine* constructed? Are they lined with wood?

A. No; the bulkheads are iron and not lined with wood. They are floored with gratings—a wooden flooring; the powder is kept on wooden racks. The shells are stowed in chocks.

(To be continued.)

British Coast Trade Passenger Steamer.

A fine addition to the Irish Channel fleet of the London and North Western Railway Co., S. S. Cambria is here shown, with a group containing the chief officials of the company. The new vessel is a twin-screw express passenger steamer carrying nothing in the holds except baggage and the parcel mail in transit for the British post office. She was built by William Denny & Brothers, of Dumbarton, and her dimensions are: Length, 337 ft. 6 in.; breadth, molded, 39 ft.; depth to awning deck, 24 ft. 9 in.

S. S. CAMBRIA FOR LONDON AND NORTH WESTERN RAILWAY CO., AND GROUP OF OFFICIALS.

Her gross tonnage is 1,842 tons. Forward the draught is 11 ft. 3 in. and aft 11 ft. 10 in. She is a handsome vessel of the seagoing type, built to withstand the tremendous gales which are encountered during much of the year. She has two pole masts and two stacks of the usual buff color, adopted by the company, with black tops.

The first-class dining room is on the main deck forward of the funnels and can accommodate eighty passengers at a sitting. It is finished in

waxed wainscoat oak, and the upholstery is terra cotta frieze velvet. The floor is laid with Brussels carpet and the ceiling finished in gold and white. The ladies' saloon on the main deck is finished in decorated sycamore panels and upholstered in blue frieze velvet. As the trip is so short little sleeping accommodation is necessary for the use of passengers. There are several other saloons for passengers of both sexes. In the steerage at the after end of the vessel there is also ample passenger accommodation. The crew are berthed forward in the forecastle, and the firemen amidships alongside the machinery spaces. The deck officers and engineers, with the exception of the chief officer and captain, are berthed in a house aft on the promenade deck. These officers have a separate house on top of the bridge deck.

KEY TO GROUP ON PAGE 25.

The triple-expansion engines are from the designs of Walter Brock and are balanced on the Yarrow-Schlick-Tweedy system. They have cylinders 26 in., 40 in. and two 43 in dia. There are 8 single ended boilers. There is a very complete installation of electric apparatus made at the railroad works of the company at Crewe.

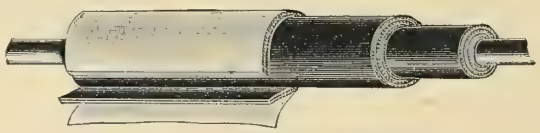
The mean speed of the Cambria on Clyde trials was 21.4 knots. Her first across-channel trip from the company's pier at Holyhead to the landing at the North Wall, Dublin, a distance of 64 miles, was made in 3 hours, 50 minutes. There was a gale blowing. A key to the group of persons gathered under the navigating bridge of the new vessel, page 25, is here given. The numbers and names are: (1) Lord Stalbridge, chairman of the London and North Western Railway Co.; (2) Captain Varian, commander of the vessel; (3) Peter Denny, shipbuilder of Dumbarton; (4) Joseph Bishop, secretary to Lord Stalbridge; (5) C. E. Grasmann, outdoor goods manager, Euston, London; (6) F. W. Webb, M.E., locomotive superintendent London and North Western Railway Co., Crewe; (7) A. J. Orr, superintending marine engineer; (8) Captain Binney, marine superintendent; (9) F. T. Hinsman, outdoor goods manager, Euston, London; (10) Mr. Whitlaw, Dublin agent; (11) F. Ree, chief goods manager; (12) G. W. Skipworth, Irish manager L. & N. W. Ry. Co.

This corporation is the largest in the United Kingdom, having a capital stock of about $500,000,000. The new boat is now in regular service under command of Captain Thomas James Varian, the commodore of the line.

IMPROVED APPARATUS.

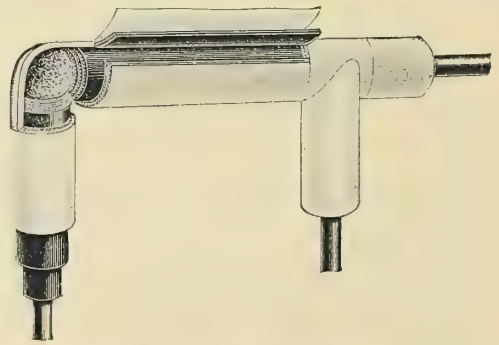
Gast's Brine Pipe Covering.

Pipe covering is usually associated with steam mains, but there is also a necessity for proper covering of pipes carrying brine in the refrigerating plant, which now forms a part of the machinery installation of every well-equipped vessel. Where these pipes are carried without



COVERING ON STRAIGHT PIPE.

any non-conducting covering there is, of course, a constant formation of ice, which has the familiar frosted appearance. This is quite unnecessary for the proper working of the plant and a nuisance besides, as variations of temperature in the plant, caused by stoppage for instance, cause drippings and general sloppiness. Gast's Air Cell Brine Pipe Covering, here illustrated, is guaranteed to effectually prevent the warm air of a compartment from reaching the actual pipe, thus preventing the condensation of the contained vapor on the pipes and accompanying losses by absorption of heat. The covering is composed of



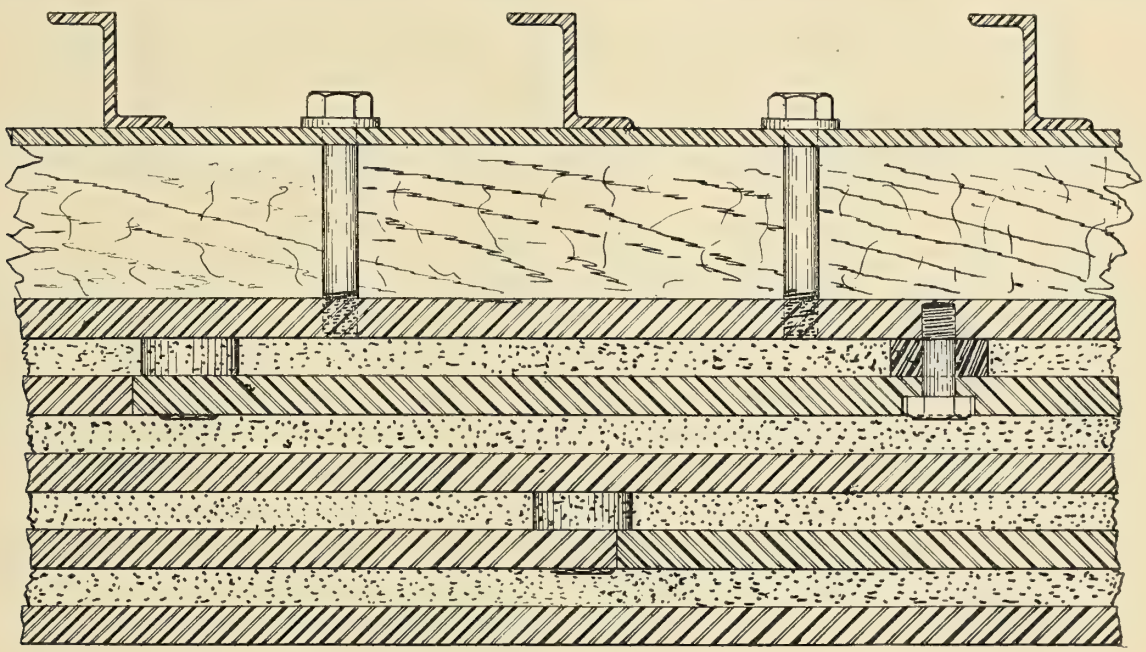
COVERING ON JOINTS.

water proof materials taking the form of a number of concentric rings of small air cells, each of which is air tight. The application of the covering is simple and the makers claim for it great durability. They also guarantee that the application of this covering to water pipes will prevent freezing, even at very low temperatures. It is made by the New York Fireproof Covering Co., 26 Cortlandt St., New York.

McAllister System of Armor Plating.

During the consideration of the Naval Appropriation bill in the House of Representatives, Congressman Mahon, of Pennsylvania, offered an amendment, appropriating $1,000 to be expended in testing the McAllister system of armor plating. Although the amendment was ruled out on a point of order, as being new legislation, it created considerable discussion and favorable comment from a number of influ-

ential members. The accompanying sketch will illustrate the ideas of the inventor, and they seem to be based on good mechanical principles. The object is to substitute a "built up" plate for the solid plate, which is now almost universally used. There have been many "built up" plates experimented with, but the system proposed is, for example, to use five 2 in. plates, with spaces of equal width between them, instead of a 10 in. solid plate. The principle involved is that advantage is taken of the elasticity of the metal, inasmuch as each plate in succession will have to be bent in so that it will touch its adjoining plate, before it can be punctured. A rather homely illustration of the principle is that of a man trying to drive a nail into a piece of thin wood which has no backing. The hammer will fly back, without the nail making much of an indentation into the wood, whereas if the strip is supported solidly at the back, no difficulty is encountered in driving the nail through the wood. In the proposed system, the plates are separated by steel washers through which tap bolts are used for securing the different layers in position. The spaces between the plates are to be filled with corn pith cellulose, a material very light and elastic, which possesses the additional quality of swelling out when wet, which would tend to close the hole, should the plate be entirely punctured. Experiments have been made by the inventor, on a small scale, which go to show that a plate built on this system possesses many points of excellence. Some of these are of special interest in these times of war preparation. (1.) It can be made for about one-quarter the cost of solid plate (now about $400 a ton), as any ordinary rolling mill can turn out plates of this description, while with the system now in vogue armor plate in this country can only be made by two steel mills. (2.) A much more uniform grade of material can be used, owing to the fact that each plate will receive the same amount of working in the process of manufacture. The Harveyized nickel steel plates have only the outer surface hardened for a depth of 1 to 1 1-2 in. In the proposed system, by the use of oil tempered, nickel steel, of high tensile strength, there will be six surfaces of uniform hardness, which must be punctured by a projectile before the plate is penetrated. (3.) With the use of solid plates there are, of necessity, joints where the plates butt together, which are undeniably sources of weakness. In the McAllister system, by "breaking joints" in the different layers, a practically continuous belt of armor plate is presented to the enemy's fire. (4.) The rapidity with which this system of armor plating could be manufactured and fitted to a vessel is certainly a great advantage, under circumstances like those existing at the present time. To make and secure in place the solid armor on a vessel like the "Kentucky" or "Kearsarge" would, under the most favorable conditions, occupy at least one year. The "built up" system, such as is illustrated here, could easily be applied to a battle ship within three or four months' time. This system has been brought to the attention of several armor experts, who agree that it is of sufficient promise to warrant a thorough test at the hands of the navy officials. It would certainly be a ready means of affording protection for some of the auxiliary vessels recently purchased. The inventor is a member of the engineer corps of the U. S. Revenue Cutter Service.



SECTION OF MCALLISTER SYSTEM BUILT-UP OIL-TEMPERED NICKEL STEEL ARMOR PLATE.

MARINE ENGINEERING

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IT would be interesting to know the present opinion of those members of Congress who in the past have blocked the way of naval progress, supposing, of course, they have acted from conviction. To prepare ourselves for war with a fifth-rate naval power we have been compelled to scour the shipyards of Europe for naval vessels, and to be content, at that, with a few comparatively insignificant ships. Of these, two, at least, will not be of the slighest practical value during the period of hostilities, as the "Abrouill" and "Somers" will not be allowed to sail from the English ports where they are now lving. The previous apathy of Congress has also forced the Navy Department to the necessity of purchasing, and placing in commission, numerous small vessels, for offensive purposes, which were never intended in design or construction for such use. Should any serious loss of life result from the employment of these necessarily inefficient vessels the responsibility will rest entirely with these members of the House and Senate. With talk of "entangling alliances" on the one hand and pretended economy on the other, they have declined to vote the money necessary for the construction and proper equipment of a navy, commensurate with the importance of the foreign interests of the United States. It has thus come about that many unthinking persons blame the officials of the Navy for our unreadiness, when there is no ground whatever for a word of censure here. In the various departments of the Navy there are to-day as thoroughly informed and capable men as can be found in any navy in the world. Without appropriations, their knowledge and ideas cannot be productive of results. There is no profit in worrying about the past, however, if it is an example that is profited by. In the passage of the Naval Appropriation bill, with additions by the Senate, as recounted elsewhere, there are signs of faint appreciation of the present requirements. No advance has yet been made with the proposition to speedily construct a number of torpedo boats, a measure which has the hearty support of Chief Constructor Philip Hichborn and Engineer-in-Chief George W. Melville. Had the bill been pushed through Congress, work would even now be pretty far forward on the boats, and the contracts would have the splendid effect of raising the standard of workmanship in many of the yards which would likely get orders. Now the greatest need of the Navy is capable engineers, and, indeed, the negligence of Congress in this direction has allowed our fleets to be confronted with possible disaster. It is a solemn fact that there are not enough Regular Engineer Officers in the Navy to-day to efficiently officer our ships *in time of peace*. The condition is not new, as for ten years past Engineer-in-Chief George W. Melville has warned the country of the consequences of having an insufficient number of officers in the engineering branch of the service. Under the emergency law, which we note elsewhere, the Navy Department is now given the power to appoint from civil life a number of commissioned and warrant engineer officers in the Navy, who are to have relative rank not exceeding that of lieutenant. They shall serve "only during the continuance of the exigency under which their services are required." Engineers can now file their applications, and, temporarily at least, the difficulty will be bridged over. It will be a splendid opportunity to select a number of men for permanent duty in the Engineer Corps of the Navy.

NO recent action of Congress was more gratifying to all persons interested in marine work than the appropriation of $330,000 to pay a rightful claim on the Government to the heirs of John Roach. This claim was for compensation for the use of the Roach shops, at Chester

and New York, by the Government, for a period of twenty months, while finishing the cruisers Atlanta, Boston and Chicago. The story of the dealings between the Government and John Roach, when the first ships of the original White Squadron were built, is familiar history. The contract awarded the late Mr. Roach by the Arthur Administration for the construction of the naval vessels Dolphin, Atlanta, Boston and Chicago called for the completion of all four within eighteen months. This time limit was almost a guess, for there was no precedent by which an accurate estimate could have been made. The builder had so much confidence, however, in his great skill that he willingly accepted the conditions. As it turned out, he was unable to comply with this clause. Other complications ensued. A new Administration had come into office and very promptly showed an unfriendly spirit toward the Roach yard. The Dolphin was condemned as structurally weak, and one of the legal advisers of the Government construed the Roach contracts in such a way as to leave no alternative for Mr. Roach but an assignment. Following this came the occupation of his shops by the Government, which took twenty months to complete vessels already in an advanced stage of construction; vessels which its predecessors in office had decided could be built outright in eighteen months. John Roach did not long survive this harsh treatment, and went to an untimely grave, done to death by political intrigue that took no account of his long and splendid services to his country in helping to build up its merchant marine. A monetary compensation is no offset to an injustice which the pages of our naval history will ever record, but it is a substantial evidence of recognition of that wrong.

AN announcement appears in the daily press that Theodore Roosevelt, Assistant Secretary of the Navy, has resigned, with the intention of raising a regiment of rough riders, to join the auxiliary forces for operations in Cuba. The Army's gain will be the Navy's loss. It would seem, indeed, as though the gain to the army of occupation would not counterbalance the loss to the forces on sea. The patriotism and courage which Mr. Roosevelt has, and which neither compliment nor criticism can affect, are surely more needed in these serious times in the counsels at Washington than in the thickets of Cuba. It is hardly open to dispute that the successful leadership of a body of irregular horse calls for lower intellectual qualities than the Assistant Secretaryship of the Navy, with a seat on the Board of Strategy. There are many frontiersmen qualified for the former, and exceedingly few from town or country who could fulfil the duties of the latter, without risk of blunder, if not disaster. Mr. Roosevelt's connection with the Navy has been an inspiration. Intellectual, vigorous, just, with capability, not only for great problems but little details, with a proper perspective of inflexible formulæ and precedent, without naval prejudices, and ever with singleheartedness for the nation's good, he is close to the ideal. For a man of his spirit to live in safety at Washington would call for a greater sacrifice than to be in the vanguard in battle; but such service the country needs. We sincerely hope that Mr. Roosevelt may be reasoned into an abandonment of his plans to go to the front.

AS illustrating the difficulty of securing accurate information at long range concerning the equipment of vessels, the case of U. S. S. New Orleans is in point. The original plans of this vessel, which were reproduced in the April issue, show the four 6-inch main battery guns twin-mounted as bow and stern chasers. Upon the arrival of the cruiser in New York we found that a rearrangement of her batteries had been made, and that the bow and stern 6-inch guns were mounted singly. The other two 6-inch guns are in the waist with broadside discharge. Before the arrival of the vessel here there was some doubt about the type of boilers she carries, which were supposed to be Bellevilles. They are of the Scotch type. The engines are by the English engineers, Messrs. Humphrys, Tennant and Company, Deptford, London. Coming across, the engine room staff of the New Orleans had many laughable experiences in translating the various instructions on the signals, valves and handling gear, which were all in Spanish.

REGARDING the recent breakage of the starboard outboard shaft of the American liner Paris, while bound east, which was noted in our April issue, we are informed upon the authority of Mr. James S. Doran, Superintending Engineer of the line, that the shaft was not made of nickel steel, but was of the highest grade of material for the purpose, made by Messrs. Vickers, of Sheffield, England.

CORRESPONDENCE.

[Communications on matters of interest to marine engineers, for insertion in the correspondence department, are solicited. These, wherever possible, should be supplemented by rough sketches or drawings, which will be reproduced if necessary to illustrate the subject, without cost to the writer.

Full names and addresses should be given, but publication of these will be withheld where requested.

We do not assume responsibility for the opinions expressed by correspondents.]

Comment on Phenomenon in Propeller Blades.

In your April issue I noticed an article by W. S. Smith, U. S. N., in which he says that on the propellers of several Atlantic liners the following edges of the bronze blades were slightly bent or curled for several inches, and he expresses surprise that this bend projected aft from the driving faces. He apparently does not believe that the change of shape was due to the blades coming in contact with an unyielding substance when going astern, but looks elsewhere for an explanation. The phenomenon, I believe, can be explained thus: Any distortion of a blade would naturally be noted at the dry docking of a ship, and if the same were excessive, the blade would be condemned as being too weak. This is of very rare occurrence, as nearly all blades in use always present the same appearance, as far as pitch and overhang are concerned, at each succeeding examination, leaving accidents, corrosion, etc., out of the question. The shape the blades assume when working under full power, however, is unknown. It is natural to suppose that they bend forward at the tip, and the thrust also tends to diminish the angles of the surface, or, in other words, to reduce the pitch, as stated in Durand's new book, "Resistance and Propulsion of Ships." The statement, no doubt, is true, as, with few exceptions, in all high powered fast running vessels the slip is greater than usual.

Let us now consider the effect of this reduction in pitch or twisting action on the material of the blade. The twisting takes place around an axis passing through the center of the hub and the center of the section at the root; and if the blade is symmetrical this axis will pass through the center. The strain due to the twisting action will be nil at the axis and greatest at the edges, where it will be in the nature of a tensile strain in the direction of the length of the edge. The combined bending and twisting strain will not be as serious in a symmetrical vertical blade as it will be in a blade that has athwartship overhang. In the latter case the axis will come close to the leading edge which will consequently receive very little strain, while the following edge will be the farthest away from the axis and there the strain will be the greatest; and if there is not enough material at this edge, the material will stretch beyond its elastic limit and will be reduced in area, but retain the sharp edge. When the engine stops and the blade comes to rest it will again assume its normal shape, with the exception of the following edge, which, having been pulled beyond its elastic limit will now be compressed. This compression will not compel the material to flow out to its former position again, but will compel it to curl aft due to the twisting action. As the blade section near the root is heavy, and the surface near the tip approximates a plane surface it is evident that the greatest amount of stretching of the edge will take place about half way between these points.

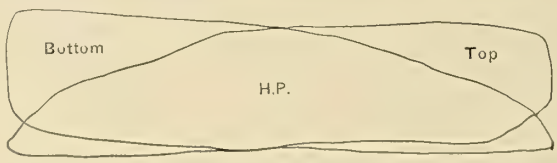
Most of the large blades nowadays are built so that the backing surface of every section is the arc of a circle, and consequently the blade is thickest at the center line of its width. There are some older types of blades with large overhang in which the thickest part of their sections is nearest to the following edge at a distance of about one-quarter the width of the blade. The object of this was to reduce the angle of entrance of the backing side, but it is a question whether the coarse angle of leaving would not nullify all the advantage gained.

According to the above reasoning this form of blade ought to be stiffer and give less slip, at the same time it would not be any heavier and the heavier section near the following edge would not curl.

NEWPORT NEWS.

Query About Indicator Card.

I enclose you a card taken from the H.P. engine of our steamer. There is a defect which I wish some of your readers would explain to me. I know of three sets of engines built by the same builder that show identically the same defect. Why does the top corner round off instead of being square? Raising the



valve does not make any change in that point of the card. Particulars are: Engines, triple expansion; cylinder, 22 in. dia. and 28 in. stroke; revolutions, 102; boiler pressure, 128 lbs.; spring, 80 lbs.; travel of valve, 5 1-4 in.; valve, 15 in. dia.; cutoff, 2 in. (?) valve takes steam in center; lead, top and bottom, 1-16 in. I should like to hear from some card experts.

POTOMAC.

In Explanation of Walschaert Valve Gear.

This valve gear is a modification of the gear which has been described in many works on the subject under the name of Heusinger von Waldegg. Referring to the diagram on page 34 of the November, 1897, issue of Marine Engineering, a part of which is here reproduced in Fig. 1, the only change necessary to bring it to the original Heusinger motion would be to replace the link A C, connecting the valve lever A F with the crosshead, by a pivoted socket attached to the crosshead, through which the valve lever slipped as it was driven back and forth. The change simply amounted to replacing one method of connection by, what is in this case, a better mechanical device.

The movement of the valve for a given movement of the piston can only be approximated by any method of analysis, but even such an approximation is of value to the designer. It is to be remembered that the simpler valve diagrams give only the relative movement of a valve and the crank, and not of the valve and piston, it being assumed that it is convenient to locate the piston position from the crank position. With a gear of this kind the piston position is an essential point in determining the movement of the valve.

To determine the movement of the valve for any movement of the piston, let us take the Zeuner diagram for a basis and see just what it means. In Fig. 2 let O A be the crank, O B the eccentric and B C the eccentric rod, assumed here to be so long that the movement of C along O C is the same as the horizontal movement of B. Let O D represent the center of the movement of B, and lay off O E so that D O E is equal to B O A. O E will now be the position of the crank when the point C is in its middle position. O F at right angles to O E will be the crank position corresponding to the greatest distance that C has traveled to the right. If on O F we draw a circle passing through O, with O B as a diameter, we will have a Zeuner diagram showing the movement of the point C with relation to the movement of the crank O A.

In the Walschaert gear, as represented in Fig. 1, the valve obtains its movement partly from the crank and partly from the eccentric. Applying the above construction to that figure, the movement obtained from the crank itself would be represented by the

circle O B of Fig. 3, as the crank has its greatest effect on the valve when it is on one of the dead points, while that obtained from the eccentric would be represented by O A, as the eccentric has its greatest effect when the crank has moved 90 degrees from

To determine the value of this movement on the valve. The movement which is transmitted to the valve from the crosshead is the movement of the crosshead times $\frac{D F}{A D}$, Fig. 1. Or, if R is the radius of

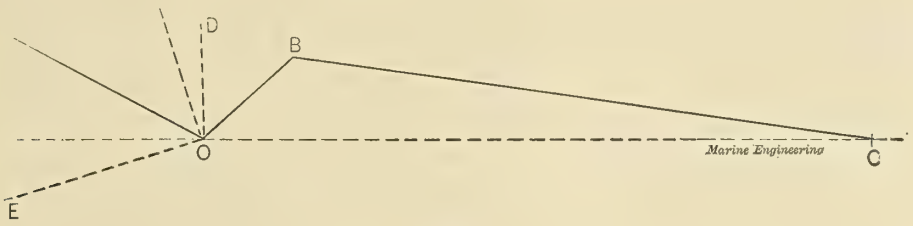


Fig. 2.

the dead point. That is, if the crank is at any position O D, the valve would be in this case a distance O E below its middle position, due to the movement of the crank, and below it an additional distance O F, due to the movement of the eccentric, the actual resulting movement of the valve being such that the valve is O E + O F or O D below its middle position. This combined movement will be a circle passing through B, O and A, and will be the Zeuner diagram for the gear.

It has been assumed that the rod B C of Fig. 2 is long in proportion to O B. In the case of the eccentric rod this is generally the case, in the case of the

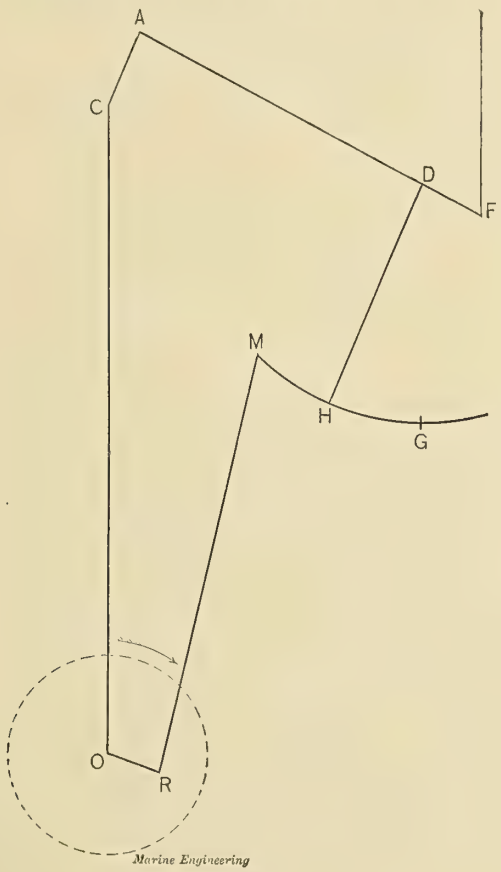


Fig. 1.

connecting rod it may not be. First considering the case where these rods are both long, the circle of the last figure represents closely enough the character of the movement transmitted to the ends of the eccentric or connecting rod.

the crank, R $\times \frac{D F}{A D}$ is the diameter of the circle O B of Fig. 3.

The movement obtained from the eccentric is transmitted to the valve through the lever M G pivoted at G and A F pivoted at A, Fig. 1, as far as this movement is concerned. The movement of H is less than that of M in the ratio $\frac{H G}{M G}$ and the movement of F is greater than that of D, or of H, in the proportion of $\frac{A F}{A D}$. The movement that the valve obtains from the eccentric, calling r the throw of the eccentric, is $r \times \frac{H G}{M G} \times \frac{A F}{A D}$. This gives us the diameter of the circle O A of Fig. 3.

The resulting travel of the valve can then be obtained either one point at a time, or by drawing a third circle through O, B and A, as shown in Fig. 3.

This gives us the usual Zeuner diagram and by drawing the lap circles, etc., the different points relating to cut-off, exhaust, etc., can be determined.

When, as in the case of marine engines, the connecting rod is short in proportion to the crank throw the circle O B of Fig. 3 is not even a close approxima-

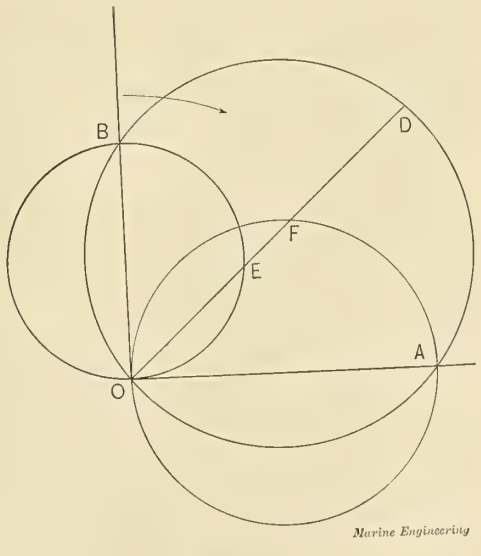


Fig. 3.

tion to the valve movement. The curve is no longer a circle, but can be found as shown in Fig. 4. In this figure O B is the same circle as in Fig. 3. O D is a circle having a diameter greater than O B in the proportion of O B to B C of Fig. 2, or as the connecting

rod is to the crank. To determine the movement of the valve for any position O F of the crank, draw O G so that the angle G O H is equal to F O D. Make O J equal to O I and D K equal to D J. Then O K is the correction to be subtracted from O F if the crank and connecting rod occupy the position shown in Fig. 2, and to be added when the angle between the two is an acute angle.

Fig. 5 shows these corrections made for crank and connecting rod values of 4 to 1, the broken line be-

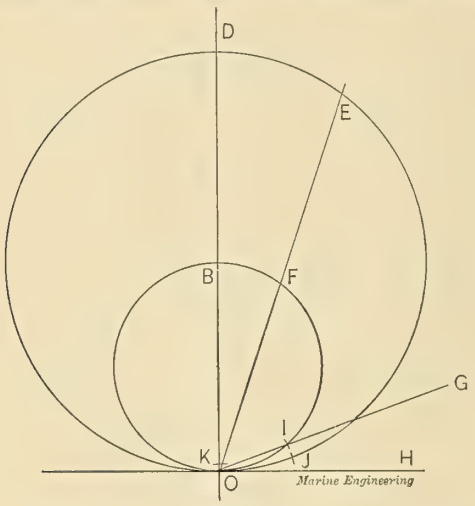


Fig. 4.

ing the circle O B of Figs. 3 and 4 and the full line the corrected diagram. The resulting valve diagram must be determined point by point. While this construction allows for the angularity of the connecting rod, there are so many other rods having similar effects on the valve diagram that it is still only an approximation and usually the dimensions obtained from the first diagram—that of Fig. 3—is a close enough approximate to begin with.

In designing a gear of this kind the ratio in which the lever A F, Fig. 1, is divided is the ratio of the lap plus the lead to the radius of the crank.

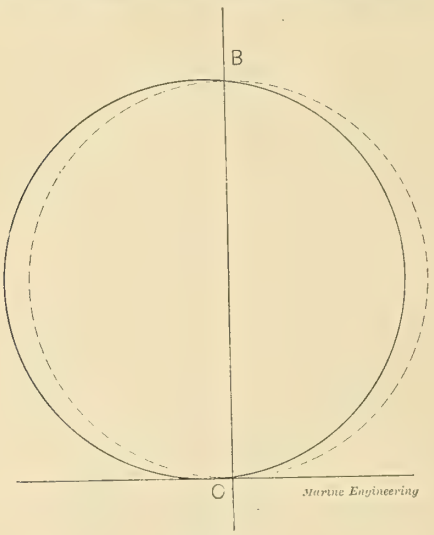


Fig. 5.

A trial value of the throw of the eccentric can be obtained by drawing the valve diagram for the maximum point of cut-off, as shown in Fig. 6. Lay off A C the lap and C B the lead. Let A D be the crank position corresponding to the point of greatest cut-off. Lay off A E equal to the lap and draw a circle through A, B and E. The distance A K is then the diameter of the circle O A of Fig. 3. This distance is the eccentric throw times $\frac{H\,G}{G\,M} \times \frac{A\,F}{A\,D}$ of Fig. 1. If, for the maximum cut-off, H can move as far out as M, the value A K is the eccentric throw times $\frac{A\,F}{A\,D}$. If, however, it can only move out so that H G is, say, .8 G M, the value of the throw is $1 \div .8$, as much.

The use of this gear for marine work is not likely to greatly increase. It is used on quite a number of foreign locomotives and has been tried in this country, and it has been found that it has no advantages over an ordinary link. It is more difficult to adjust, is quite as expensive, and is more affected by wear.

We are entirely in accord with Prof. C. H. Peabody as to the value of a model for determining the exact movement of the valve for a given engine—*if the gear is already designed.* A Zeuner diagram is, however, of value to the designer of such a gear in that it enables him to determine the value of many of

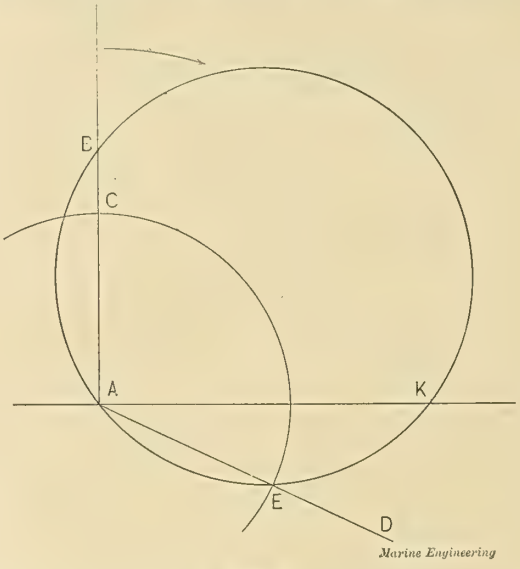


Fig. 6.

those proportions of the gear which, as Professor Peabody says, "are imposed upon the diagram by the general construction of the engine," and which must be known before a model can be constructed.

The Zeuner diagram is of considerable value in connection with a model, as it gives a clue to the direction in which changes in dimensions should be made to produce desired results.

C. R. Stewart.
H. W. Spangler.

Tail Shaft Breakages.

Many breakages of tail shafts of ocean steamers are due to the galvanic action caused by the contact of bronze and steel in the presence of sea water. I should like to hear from other correspondents regarding experiments that have been made with the object of ascertaining what composition of bronze will cause the least amount of galvanic action. White metal sleeves, having a minimum amount of copper in their composition, are said to cause very little galvanic action on the steel of the shaft, and that the action takes place on the sleeve itself. I understand that copper is electro-negative to steel, while zinc is electro-positive, and therefore the galvanic action affects either the shaft or the sleeve according to the preponderance of the copper or zinc in the sleeve. P.

EDUCATIONAL.

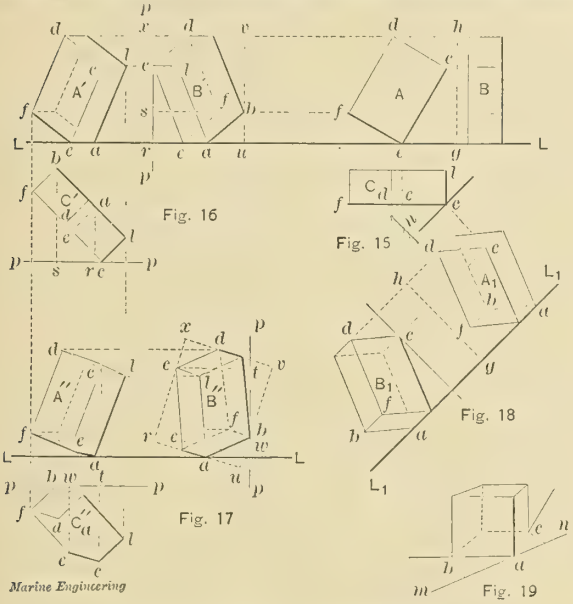
THE ART OF MAKING MECHANICAL SKETCHES —FOR MARINE ENGINEERS.—IV.

BY PROF. C. W. MACCORD.

In the preceding article an explanation was given of the method of determining, from the projections of a prism in its simplest position in relation to the paper, the correct representations of the same object in three other positions, each of which was derived from the original one, by revolving the prism about one or the other of its three adjacent edges.

Each of these axes is perpendicular to the paper in one of the three views, where it appears as a point, and neither the from nor the dimensions of that view are changed by rotation about it; and we have seen that in the other two views one set of dimensions is also unchanged. Clearly these things are true, whether the original object be a prism, or anything else; and even if it be one, it need not be placed in the simplest position in order to revolve it about either axis. We now proceed to consider the results of performing these rotations consecutively.

In Fig. 15 the prism is represented in the same position as in Fig. 11—the top view for convenience being placed below the front view, in which one rotation



FIGS. 15, 16, 17, 18, and 19.

has already been performed. Let us next turn it about a vertical axis—that is, one perpendicular to the paper in the top view C; since this remains unchanged, it is in Fig. 16 simply copied in its new position C′. Now in the front view A′, each point must be vertically over the position of the same point in the top view; and its distance above L L is the same as in Fig. 15, since each point in revolving about a vertical axis must move in a horizontal plane—in other words the heights are unchanged, as explained in connection with Fig 13.

Next, imagine a vertical reference plane *p p*, for convenience passing through the nearest point *c* in the top view; this will also be seen edgewise as the vertical line *p p* in the side view B′. In constructing this view it is only necessary to keep in mind that the height of each point is the same as in the front view, and its distance from *p p* the same as in the top view; for instance, *c* lies in the reference plane, and *a r*, *b s*, are the same in B′ as in C′.

It remains now to rotate the prism about the third axis, that is, one perpendicular to the paper in the side view. This will affect neither the form nor the dimensions of B′, which in Fig. 17 is accordingly copied in a new position as B″.

The simplest and best method of making this copy is this: Complete in Fig 16 the rectangle *r u v x* within which B′ is inscribed, and draw this first in Fig. 17 at the proposed inclination, and on its sides set off the distances *r a*, *r e*, *r c*, *v d*, *v b*, etc., as measured on Fig. 16. This simply amounts to constructing the various angles, acute and obtuse, by means of offsets instead of by means of arcs; but it is by far less laborious and much more reliable.

As was shown in connection with Fig. 12, the *breadths*, or distances from right to left, in the other two views, are not affected by this rotation, and will therefore be the same as in Fig 16. In constructing the froint view A″, then, the points *f*, *d*, *l*, etc., will appear directly under the positions of the corresponding points in A′; their distances above L L being of course the same as in B″.

The top view C″ is constructed from the other two, in a manner precisely similar to that used in Fig. 12; a vertical reference plane *p p* in the side view will appear in the top view as *p p* parallel to L L, and the distances of the various points from this plane are the same in C″ and in B″. The position of such a reference plane is arbitrary—in this case it passes through the point *b* on the extreme right in the side view, which is therefore the most remote point in the top view; other points as *c*, *e*, etc., will appear directly under the corresponding points in A″, the distances *c t*, *e w*, etc., being the same as in the side view.

We have now reached the most complicated position in which the prism can be placed in relation to the paper; none of the lines is shown in its true length, nor does any angle appear as a right angle in any one of the views. Consequently no one of the faces appears as a rectangle, but, recollecting that all lines which are parallel in space will appear parallel in any projection, and also equally foreshortened, we perceive that every face will appear as a *parallelogram*, with its opposite sides equal and parallel to each other. If this be kept always in mind it will be found not only an excellent check upon the accuracy of the work, but of the greatest service in facilitating the construction.

Since the three adjacent edges of the prism in its original position represent length, breadth and thickness, the only three dimensions in space, it is clear that by successive rotations about them, as above described, the object can be brought into any possible position in relation to the paper; and it is not possible to represent it correctly in the final position of Fig. 17, or in the intermediate positions of Figs. 15 and 16, without performing these revolutions, either actually or virtually. It is, of course, to be understood that these special positions are merely selected for illustration; the directions as well as the angles of rotation are entirely arbitrary, and the order of succession of the axes about which the rotations are made is also a matter of indifference.

It was mentioned in the foregoing that these rotations must be made either actually or *virtually*: in passing from the position of Fig. 15 to that of Fig. 16, it is not necessary to *copy* C in the new position C′, which represents it after turning through a given angle in a certain direction. Instead of this, let the observer move through the same angle in the opposite direction so as to look horizontally toward C, as shown by the arrow *n*; then, as explained in connection with Fig. 14, the horizontal plane will appear as the line L_1 L_1 perpendicular to *n*. In constructing the view A_1, each point is projected perpendicularly toward L_1 L_1, and its distance above that line is the same as its distance above L L in Fig. 15—as for instance *g h*, which measures the height of the upper edge.

B_1, in Fig. 18, is a view of A_1 from the left, and the distances of the various points from a reference

plane through *c* are taken by measurement from C just as they were from C′ in Fig. 16. This done, it is clear that C is a top view not only of A in Fig. 15, but also of A_1 in Fig. 18.

The labor involved in passing from the original position of the prism to that given in Fig. 17, by the above process, is so great the writer was led some six years ago to seek for some means of dispensing with a portion of it. This he succeeded in finding, by availing himself of the following principle, viz.: That simultaneous rotations about two intersecting axes are equivalent to a single rotation about a third axis lying in the plane of the other two, and passing through their point of intersection. Thus in Fig. 19, a rotation about *a c* will raise *b* above the plane *b c*, and a rotation about *a b* will produce the same effect upon *c*; while a rotation about *m a n* will do both things at once. The height to which *b* and *c* will be raised above their original positions, will evidently be directly proportional to their distances from the axis; by properly proportioning these distances, then, those two points can be raised to any given height: and since *a* remains fixed, the inclination of the plane *b c* to its original position will thus be determined. This done, the prism can be placed in any conceivable position by rotating it about a vertical axis passing through *a*.

The application of this is shown in Fig. 20, where A, B, C represent the prism in its simplest position. Let *m n*, lying in the horizontal plane L L, and passing through the corner *c*, be the axis about which it is

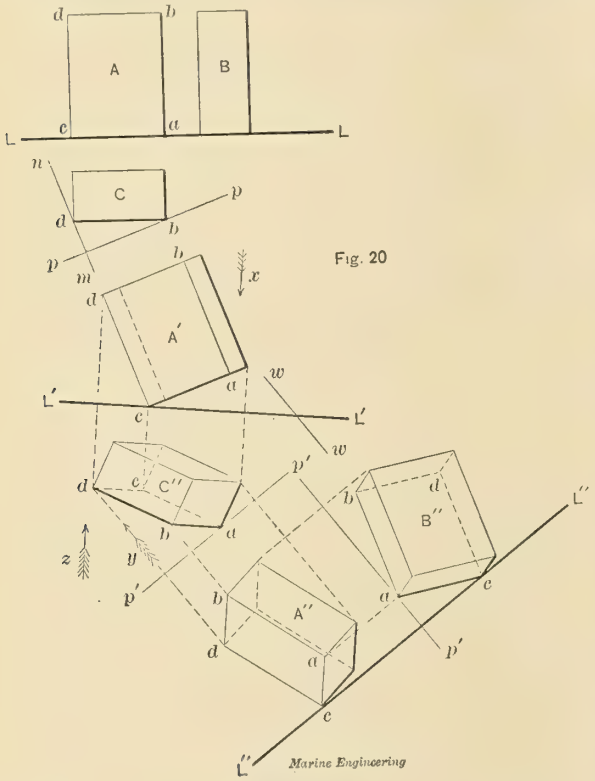


Fig. 20.

first to be revolved; then the first step is to construct the front view A′, looking in the direction *m n*—which is done precisely as in Fig. 14.

Supposing the angle of rotation to be assigned, draw L′ *c* L′, making that angle with the plane of the base, *c a*, then L′ L′ will represent the horizontal plane in its new position with reference to the prism.

The next step is draw a top view of A′, looking down upon it in a direction perpendicular to L′ L′, as shown by arrow *x*. In constructing this, we draw a reference plane *p p*, perpendicular to *m n* through the corner *b* of the original top view C. This obviously contains the vertical edge *b a* of the prism; consequently this edge will be parallel to L′ L′, and so will all the other edges which were originally vertical, while their distances above *a b* in the new top view C″ will be the same as their distances from *p p* in the original one.

Now A is a front view of C″, seen in the direction of the arrow *z*; supposing it to be finally required to rotate the prism about a vertical axis through a given angle in one direction, then instead of copying C″ in the new position which would be thus determined (as was done in Fig. 16), we move around through the same angle in the opposite direction (as in the construction of Fig. 18); which determines the direction of the arrow *y*, for the construction of the final front view A″. In this view the horizontal plane appears as L″ L″ perpendicular to *y*; all the points of C″ are projected perpendicular toward it, their distances above it being equal to their distances above L′ L′ in the view A. And from A″ and C″ the side view B″ is laid out by means of the reference plane *p′ p′* exactly as in Figs. 16 and 18.

We have, then, that between the simplest and the most complex position, but one intermediate view A′, and that very easily constructed, is required; the problem is thus reduced to its very lowest terms, *and the labor involved is reduced to a minimum.*

In practice it would often be necessary to have the arrangement such that the base line L″ L′ should be horizontal upon the paper. And usually there would be no reason for preserving a record of the process of construction, and consequently no necessity of inking in the intermediate view A′. Nor need it be even penciled upon the finished sheet—it may be drawn, in connection with the top view C, upon a piece of tracing paper; then drawing a line *w w* parallel to the arrow *y*, the tracing paper may be pinned down over the sheet, taking care to adjust it so as to make *w w* vertical. Then the view C″ may be constructed upon the sheet below the edge of the tracing paper, which is to be finally removed.

It has been preferred to adhere throughout these explanations to the simple prism as the object to be represented: the manipulations by which the final position is reached, and even the processes of constructing the third view by means of the other two, are apt to be quite perplexing to a beginner, even in dealing with so simple a subject as that; and it will be found that the study of a model—say a block of wood, which can be placed in the various positions and examined at leisure, will be of great assistance to those who at first find difficulty in *reading* the drawings, that is, in forming a clear mental picture of just how the object appears in space, by the aid of the representations alone.

The principles and the methods, however, are perfectly general, and those above set forth are all that are required in drawing the most complex objects.

In Fig. 21 is shown a very simple exercise, the object being a hexagonal pyramid, with one face lying in the horizontal plane. At the right, is a view looking perpendicularly against the plane of the base, which is therefore seen in its true size and form. The circle circumscribing the base is first drawn, and the hexagon laid out within it—supposing, that is, that the inclination of the axis is assigned.

The point *f* in this end view is then projected back to *f* in the horizontal plane in the front view, and the base *f b* then drawn perpendicular to the axis. The rest of the construction should require no explanation; but attention is called to the fact that the points *a*, *b*, *c*, etc., in the top view, must be points in the curve which is the foreshortened representation of the circle in the plane of the base.

Had the base of the pyramid been a polygon of twelve sides, the construction of the drawing would have been just as simple as it is now. Then, however,

there would have been twice as many points located in the foreshortened view, and the curve would have been more accurately defined. This leads to the consideration that the inclined projection of a circle might be made by merely finding the projections of any desired number of points in it. The same would of course be true of a curve of any other form. In-

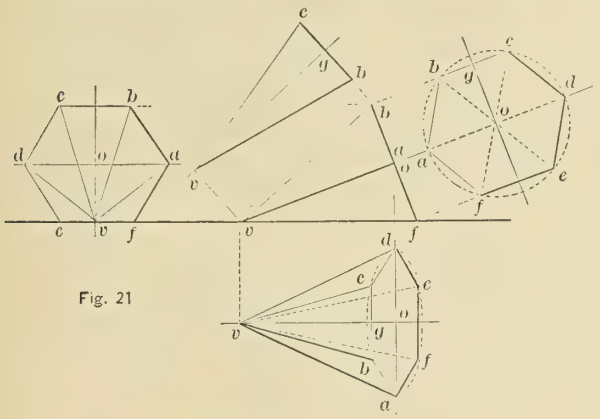


Fig. 21

Fig. 21.

deed in the case of irregular curves, or those of unknown properties, that is the only method practicable. But the inclined view of a circle being an ellipse, the work may often be simplified by making use of known properties of that curve. Such views are so often required as to call for a more extended examination of this matter, which is reserved for a subsequent article.

QUERIES AND ANSWERS.

Q. I expect to take my examination soon for a certificate, and I am a little uncertain about the matter of staying boilers. I am told you have to figure on these to pass the examination and I wish you could give me some pointers. BRACES.

A.—As a general rule, all flat surfaces in a boiler require some support in addition to that which can be furnished by their own strength. This depends, of course, on the size and thickness of the surface in question. If small enough in relation to its thickness and the steam pressure per square inch it will be strong enough without any stay or support. In fact the whole idea of bracing is to subdivide by the braces a large

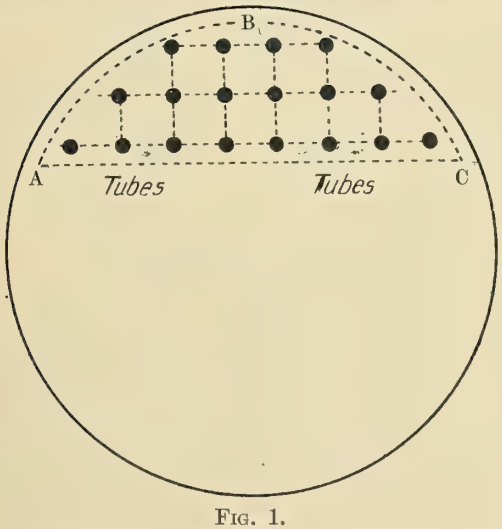


Fig. 1.

flat surface into a sufficient number of smaller surfaces, each of which shall be self supporting between the points where the braces are connected to the plate. The braces are then designed so as to be able to carry the entire load as a whole, and the parts of the plate between the braces are simply required to support, without change of shape, the part of the load which comes upon them.

To illustrate this plainly by a diagram, let Fig. 1 represent a part of a boiler head requiring bracing. Now imagine the plate entirely cut out around the dotted line A B C, and then fitted in so exactly as to make a steam tight joint. The part A B C is therefore entirely cut off from the remainder of the head, and without some special support would be blown out right away when steam was raised. Now suppose the braces to be so designed that they may be safely depended on to carry the entire load on the plate and thus keep it securely in place in the head. It simply remains then for the parts of the plate between the braces to support themselves without losing their proper shape, and the support is thus made complete. In the actual boiler head or in all similar cases where a flat surface has to resist pressure the design of the braces is worked out exactly upon these lines, and no account is taken of the strength of the plate for the general support of the load as a whole.

In designing boiler braces we have to consider two things: (1) The total load to be supported and the number of braces, or simply the load upon one brace as determined by their spacing and the steam pressure. (2) The safe load per square inch of section of brace. The total load depends on the area and the gauge pressure. In figuring out the area as in Fig. 1, it is usual to consider that a narrow ring of metal around the outside (the circumference) of the head will be well supported by the shell, and also by the tubes. The width of such band is usually taken as two or three inches, though there seems to be no good reason why it should not be taken as half the spacing or pitch of the braces. This is the same as considering the shell and tubes as effective braces or supports for that part of the plate near them, in the same manner and to the same extent as for the braces themselves. The area thus found is then multiplied by the gauge pressure, and the total load is found. In regard to the number and spacing of the braces it should be remembered that the thinner the plate the closer the spacing, and the contrary is also true. Also that a plate exposed to the hot gas, flame or fire on one side should have its braces more closely spaced than for a plate not so exposed. Thus, for example, you will have noticed the

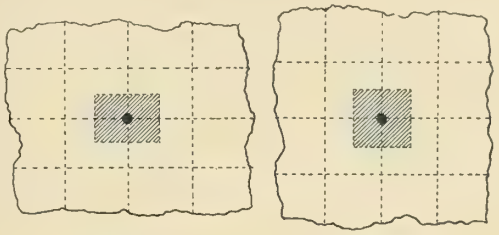


Fig. 3. Fig. 2.

screw stay-bolts for fire boxes and combustion chambers 3-8 in. to 5-8 in. thick are usually spaced from 5 in. to 8 in. between centers, 7 in. being common in large Scotch boilers. According to the U. S. rules, the greatest spacing allowed for any plate of this kind is 10 1-2 in. On the other hand, the braces for the head in the steam space are usually spaced as widely apart as 12 in. to 16 in., the latter being the greatest spacing allowed under U. S. rules. While braces are considered as supporting the plate at certain *points*, it must not be forgotten that when fitted with washers and nuts, as is common with the head braces of marine boilers, the area really supported in a direct manner is a circle 5 in. to 8 in. in diameter, and thus the area of plate between the braces is correspondingly reduced. The rules giving the proper relations betwen *pitch of braces, thickness of plate,* and *steam pressure* you will find in the "Rules of the Board of Supervising Inspectors of Steam Vessels." The present answer is, of course, concerned with the *braces* rather than with the *plates,* and this reference alone is made to the rules especially relating to the *plates.* The total load and the number of braces having been ascertained, the load on each brace is found by dividing the total load by the number. Otherwise, if the spacing is known the load on each brace is immediately found by multiplying the area which it supports by the pressure per square inch. Thus in Fig. 2 the surface supported by the brace is considered as the shaded portion, and the spacing being the same both ways, its area is the square of the pitch. In some cases the spacing is not the same in both directions, as in Fig. 3. In such case the supported area is found by multiplying together the two pitches. Thus in Fig. 2 let the side of the square be 7 in.; then the supported area is 49 sq. in. Likewise in Fig. 3 let the pitch be 14 in. in one direction and 16 in. in the other. Then the supported area equals the product of 14 in. by 16 in., or 224 square inches.

If the brace is oblique to the plate, as in Fig. 4, the load coming upon it will be greater than if square. The amount of this increase is figured in this way: Let A C be the brace inclined to the plate as shown. Let B be any point on the brace, and draw B D square to the plate. Then the increase is in the same proportion that A B is greater than D B. That is to say:

Load on brace A C : Load if brace were square : : A B : D B.

This may be found by laying down the brace on drawing paper and measuring the lengths A B and D B, or it may be figured thus: Let the slope be 1 in. to the foot. Then if A B

$= 12$ in. A D $= 1$ in. and D B $= \sqrt{12^2 - 1^2} = \sqrt{144 - 1}$ $= \sqrt{143} = 11.96$. Then the increase is in the ratio $\frac{12}{11.96} =$ 1.0033 or about one-third of one per cent. As you will perceive from this example, the increase is quite small for all inclinations usually met with in practical work.

With regard to the safe load for braces the U. S. rules provide that iron braces shall not be allowed more than 6,000 lbs. per square inch of section; while for steel, if inspected according to regulation, the allowance may be as follows: From

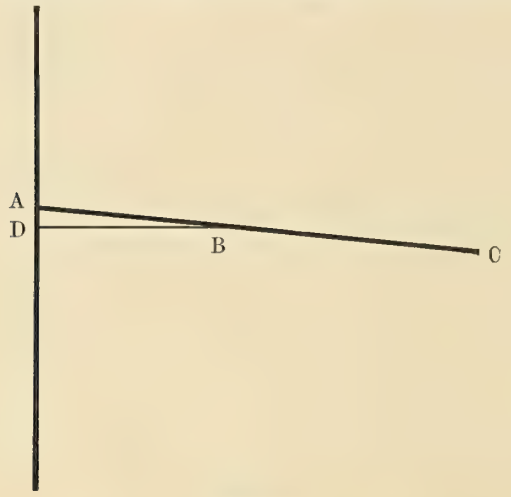


FIG. 4.

1 1-4 in. dia. to 2 1-2 dia., not to exceed 8,000 lbs., and above 2 1-2 in. dia., not to exceed 9,000 lbs., each per square inch of section. It must be carefully noted that in all cases the diameter is measured at the bottom of the screw thread, or at the smallest section. For this reason the screw threads are usually *raised* so that the diameter at the bottom is not less than that of the body of the brace.

To make the foregoing perfectly plain a few simple examples will be of aid:

(1.) In Fig. 1 suppose the area A B C is found by measurement to be 3,784 sq. in., the steam pressure being 160 lbs. Find total load?

Ans. Load $= 3784 \times 160 = 605{,}440$ lbs.

(2.) Suppose we wish to fit 18 braces. Find the load on each one?

Ans. Load $3{,}784 \times 160 = 605{,}440$ lbs.

(2.) Suppose we wish to fit 18 braces. Find the load on each one?

Ans. Load $= 605{,}440 \div 18 = 33{,}636$.

(3.) Suppose instead that we wished to space the braces 14 in. between centers each way. Find load on each brace?

Ans. Load $= 14$ in. $\times 14$ in. $\times 160 = 196 \times 160 = 31{,}360$.

(4.) Suppose, instead, that the braces were to be spaced 14 in. one way and 16 in. the other. Find the load?

Ans. Load $= 14$ in. $\times 16$ in. $\times 160 = 35{,}840$ lbs.

(5.) Suppose we wish to space screw stay-bolts for the combustion chamber 6 in. $\times$ 6 in. Find the load?

Ans. Load $= 6$ in. $\times 6$ in. $\times 160 = 5{,}760$ lbs.

(6.) What would be the load in (5) if the spacing were 7 in. instead of 6 in?

Ans. Load $= 7$ in. $\times 7$ in. $\times 160 = 7{,}840$.

(7.) What would be the area and diameter of an iron brace in example (2)?

Ans. Area $= 33{,}636 \div 6{,}000 = 5.606$ sq. in. Corresponding diameter $= 2$ 11-16 in. nearly. Probably 2 3-4 in. would be used.

(8.) In example (3) what would be the area and diameter of a steel brace allowed 8,000 lbs. per sq. in. of section?

Ans. Area $= 31{,}360 \div 8{,}000 = 3.92$ sq. in. Corresponding diameter $= 2$ 1-4 in. nearly.

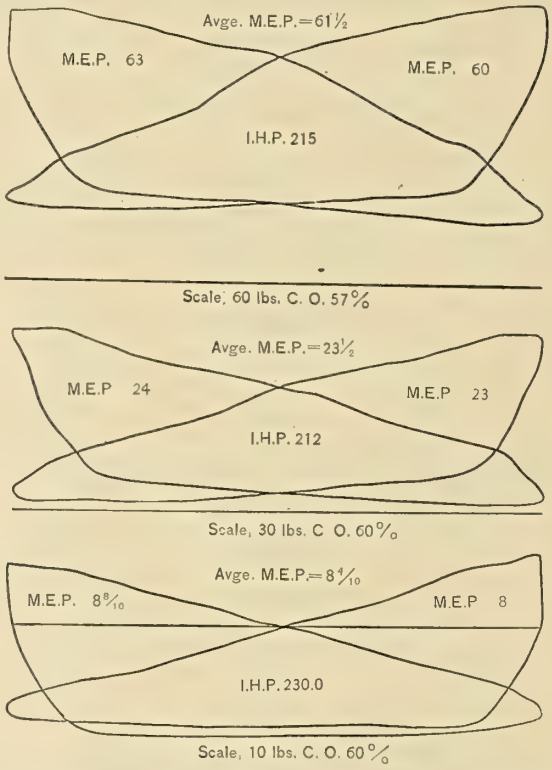
(9.) In example (6) what would be the area and diameter of a steel stay-bolt of the same allowed strength as in (8)?

Ans. Area $= 7{,}840 \div 8{,}000 = .98$ sq. in. Corresponding dia. $= 1$ 1-8 in. nearly.

Q. I inclose a set of indicator cards and will you please work out the indicated horse power, as I would like to see if it corresponds with the figures I have on them, and I would like any criticism. The engine is triple expansion, 19 in., 30.5 in., and 54 in. by 36 in. The boiler pressure is 160 lbs., vacuum 26 in., and engine speed 68 revolutions. TEXAS.

A.—From the general appearance of the cards they are evidently taken from an engine in which the high pressure crank moves to the top center in advance of the low pressure. They show a much earlier cutoff than is usual in engines of this type when running full out, and this in addition to the compression, which is excessive for 68 revolutions, would lead one to suppose that the engine was linked up when the cards were taken. The distribution of power is about as even as can be obtained in any triple-expansion job.

The admission line at the beginning of the stroke of the high pressure card shows a pressure of about 140 lbs., which is a drop of 20 lbs. from boiler pressure, and also shows a gradual drop in pressure to the point of cutoff, where it is only about 110 lbs., showing a loss of 50 lbs. pressure. This is due to the wire drawing of the steam in the steam pipe and valve chamber ports, and impairs the economy of the engine to a great extent. In good triple-expansion practice the difference between boiler pressure and the admission line ought not to exceed 5 lbs. with high-pressure steam, and the admission line ought to be parallel to the atmospheric line, or, in other



words, the steam ought to follow at full pressure up to the point of cutoff. Card (Fig. A) was taken from the high pressure cylinder of a large marine triple-expansion engine, and demonstrates what a good admission line ought to be. Many marine engines will show a drop in the high-pressure ad-

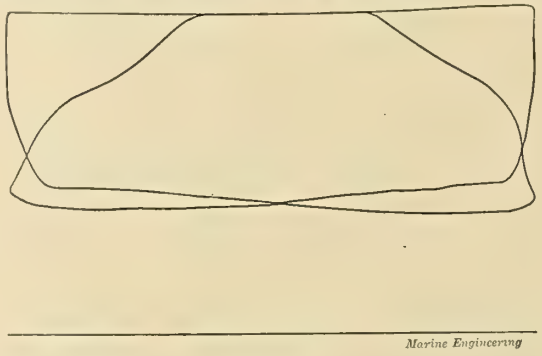


FIG. A.

mission line when they are linked up, owing to the reduced port opening, due to the decrease in the travel of the valve. The low pressure card shows a loss due to wire drawing at the exhaust port, as the engine realizes only 19 in. of the 26 in. of vacuum in the condenser. It ought to show 22 in. or 23 in. at least. The admission lines of the intermediate and low pressure cards are good, as in both cases they follow the exhaust line of their preceding cards, and show a loss of only 2 lbs. or 3 lbs. in the receivers. The early release in the high pressure and intermediate pressure cards is also a good point, as it tends to hold the receiver pressures more steady and prevents a heavy initial blow at admission in their following cylinders. The early release in the low pressure permits that cylinder to realize the vacuum much better than if it occurred at the end of the stroke.

The cards are well balanced top and bottom, and give evidence of careful valve adjustment.

ENGINEERS' DICTIONARY.—V.

Boiler Flue.—A large tube for the passage of gases. The difference between a *flue* and a *tube* is one of size only. Anything over about 6 in. dia. is usually termed a *flue*.

Boiler Hatch.—A hatchway or opening in the decks leading to the fire room, and usually appropriate in size for the passage of the boilers. See also *Boiler Trunk*.

Boiler Seating.—The seat or bed in which the boiler rests when installed in the ship. The usual form of seating consists of two or more steel plates on edge cut to the curvature of the boiler shell, and fitted with angles on the upper edge, as shown in section

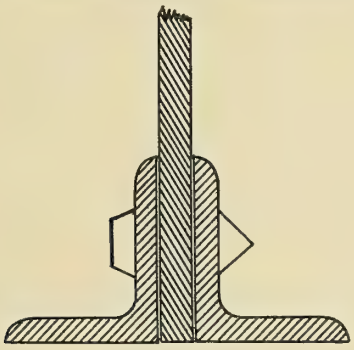


FIG. 12.

in Fig. 12. These plates are firmly secured to the structural members of the ship, and thus form a secure foundation for the weight they are to sustain.

Boiler Trunk.—A space leading from over the midship's part of the fire room to the upper deck, and bulkheaded off from the remainder of the ship. It contains the smoke-stacks and fire-room ventilators, and prevents the escape of hot air and dust to other parts of the ship.

Boiler Tube.—See **Boiler.** The material is usually wrought iron or steel, though brass and copper are occasionally used. Fire tubes are usually from 2 in. to 3 1-2 in. dia. In the small tube forms of water tube boilers, the diameter is usually from 1 in. to 2 in.,

FIG. 13.

while in the large tube varieties it may be from 4 in. to 5 in. The thickness varying with the size is usually from gauge number 14 to 6, or from about 1-12 in. to 1-5 in. Fire tubes are plain or of the *Serve* type, the cross section of which is shown in Fig. 13. Water tubes are always plain.

Boiling or *Ebullition.*—A term referring to the condition of a liquid when forming vapor with such rapidity that the escaping *globules* produce a continuous agitation throughout the body of the liquid.

DURING THE MONTH.

Contract was reported closed between the Old Dominion S. S. Co. and Roach's shipyard for the construction of two new vessels to replace the "Yorktown," sold to the Government, and the "Roanoke," sold for the Alaskan trade. The new vessels are to be upon the lines of the "Princess Anne," in dimensions about 324 ft. long; 42 ft. beam, and 27 ft. deep, fitted with triple expansion engines.

The launch of the Maine Steamship Co.'s new passenger coast liner, Horatio Hall, was successfully carried out at Roach's Shipyard. This fine addition to the company's fleet measures 320 ft. long, 46 ft. beam and 19 ft. 6 in. depth of hold. She will be fitted with triple-expansion engines, 28 in., 48 in. and 75 in., by 54 in. stroke, and with six Scotch boilers built for working pressure of about 180 lbs. Passenger accommodation is very modern and the vessel will have large cargo carrying capacity.

The organization of the Neafie & Levy Ship & Engine Building Co., Philadelphia, was effected. Sommers N. Smith resigned his position as general superintendent of the Newport News shipyard and purchased a large interest in the Philadelphia concern. The new organization of the company is as follows: Mathias Seddenger, president; Sommers N. Smith, vice-president and general manager; Edwin L. Fuller, treasurer, and J. G. Neafie Whitaker, secretary. Directors: Mathias Seddenger, Sommers N. Smith, Eli K. Price, E. L. Levy and John H. Watt. The establishment, which has long had a reputation for good work, will probably go in more extensively for new work in the future than it has for some time past. The works cover about ten acres of ground and it has a water front of about 700 ft. Various plans for the addition of new machinery and a general modernization of the plant are under consideration.

Lieutenant Unsworth and eight under officers and seamen of the French liner La Champagne, who, it will be remembered, put off from the "La Champagne" in a small boat in mid-ocean, when she was disabled, not long ago, for the purpose of getting in the track of steamships and securing aid, received a substantial recognition of their bravery. A reception was held on the vessel when she arrived in port here and a subscription which had been raised by the French residents in New York was divided. Lieutenant Unsworth received 2,000 francs, Second Master Gancamard 1,500 francs and the sailors 1,045 francs each. The Compagnie Generale Transatlantique also presented to each a sum of money and medals. Lieutenant Unsworth also received a very valuable pocket chronometer, which had been purchased by the committee of the passengers who had been on the "La Champagne" at the time of her mishap.

Plans for the construction of the new twin screw ferry steamer for the Toledo & Ann Arbor Railroad Co. call for the construction of a vessel 270 ft. long, 52 ft. beam and 18 ft. 6 in. deep molded, with 'tween decks for cars 16 ft. 9 in. high, fitted with two sets of compound horizontal engines, 20 in. and 40 in. by 36 in. and four firebox boilers 6 ft. 6 in. by 14 ft. worked at a pressure of 125 lbs. of steam. She will be launched with four tracks for twenty-four cars; also made suitable to carry package freight in place of the cars, or grain in bulk in the holds. Otherwise she will resemble the "Pere Marquette," which was extensively illustrated and described in this paper. The designer of the vessel, Robert Logan, of Cleveland, was also the designer of the "Pere Marquette," which has proved herself to be one of the most successful ferry steamers at work in any waters. The contract was awarded the Globe Iron Works.

NEW PUBLICATIONS.

THE MARINE STEAM ENGINE. *A Treatise for Engineering Students, Young Engineers, and Officers of the Royal Navy and Mercantile Marine.* By the late Richard Sennett, R.N., and Henry J. Oram, R.N. Longmans, Green & Co., London and New York. Third Edition, 1898. Size, 6 by 9. Pages 508. With many original drawings. Cloth, $6.00.

There is a decided feeling of satisfaction in store for the purchaser of this book, when he finds, upon opening it, that the author appreciates that such apparatuses as steering engines, starting engines, automatic feed regulators and grease filters form part of the equipment of modern steam vessels. We say this by way of preface to show the comprehensiveness and up-to-dateness of this work. The title of this book indeed is vastly more restricted than its scope. The character of treatment is indicated by the sub-title, as the work is perhaps more intended for the operative than for the constructive department of marine engineering. The work is the outcome of experience gained in the British Navy, the original edition having been long recognized as authority in older naval practice. It was first issued in 1882 by the late Richard Sennett, Engineer-in-Chief of the British Navy. This book gradually took its place, for all practical purposes, among those historical works which treat of trunk engines, box boilers, jet condensers and pressures anywhere from thirty pounds down. The work as now presented has undergone, in the words of the author, "a thorough revision and modernization," and at the same time has been enlarged to countenance the practice followed in the mercantile marine. The illustrations and drawings have been added to, and in this respect alone the work is the most valuable for referencee we know of. There are 412 illustrations in the book, each one well drawn, well executed and of interest. Before giving any details of the work we might say it is intensely practical, very naval, and very British. As the author, however, truly says: "During recent years there has been, as regards the engines of large vessels, a much nearer approximation to identify in mercantile and naval practice than was usual previously." The book is divided into seven sections, entitled: Introductory, The Boiler, The Steam, The Mechanism, The Propeller, General, and Appendix. These again are subdivided into chapters which, among other subjects, include an interesting review of marine engineering practice from the pioneer days to date; Work and Heat, Fuel and Combustion, which includes a very clever chapter on Liquid Fuel, Water-Tank and Water-Tube Boilers, Boiler Fittings and Boiler Preservation, Steam Efficiency and Expansion, Compounding, Valves and Valve Gears, Arrangements of Cylinders, Condensers and Minor Fittings, Propulsion, both screw and paddle, including a practical talk entitled "Co-Efficients and Curves of Performance." The Indicator, Pumps, Auxiliary Machinery, Instructions as to the Care and Management of Machinery, Materials of Construction and Theoretical Indicator Diagrams have also each a chapter. In the Appendix, Stresses and Inertia are considered, and the work closes with the Board of Trade and Lloyd's rules. There is not a waste sentence in the book, nor one which the beginner or veteran cannot read without profit. Much of it is, of course, the alphabet of marine engineering, but this is not irrevocably fixed and the true engineer must ever be the student, also. From the American standpoint there are, of course, many omissions, the beam engine and the stern wheeler, for examples, not receiving attention, and there are also some curious omissions from a purely engineering standpoint. The chapter on Valve Gears is brief and does not take account of some well known patent gears, and in the boiler chapter we noted a failure to treat of the use of retarders. The work is, however, all it claims to be and a good deal more. Its language is so simple and direct that persons not actually engaged in marine work can read it intelligently. It should be found in the library of every steam-yacht owner.

ELEKTROTECHNISCHER UNTERRICHT *und Anleitung zum Betriebe elektrischer Anlagen insbesondere auf Kriegsschiffen.* Lehrbuch für Unterofficiere. Von M. Burstyn, k. und k. Marine-Elektro-Oberingenieur. In Commission bei Carl Gerold's Sohn in Wien. Pola, 1898. Size, 6 1-2 by 10. Pages 352. With 252 drawings.

This book, issued by the Austrian Navy, is an instruction book on electricity and also an instructor in the practical running of electric plants, particularly those of war ships, and is intended for the use of the pretty officers of the navy. The amount of literature on electrical work on ship board is very limited. It is usually either very elementary, disregarding all practical questions, or explaining types of apparatus which are out of date, or contains formulæ which are unintelligible to the average mind, or treats of details which are only of interest to those who are well informed on ship's work. The book in question, however, is a very happy combination of all, as it starts with the elementary problems and leads up to the most modern practice in a way which can be easily understood by beginners. It is profusely illustrated by very carefully made drawings, every one of which clearly elucidates the point in question. Every type of dynamo is explained and valuable hints given in the running of the same. The different styles of multipolar direct driven machines as used in the Austrian Navy are shown, explaining all the details of armature and field coil windings, also the switchboards, and a very interesting account on the electrical outfit used on the latest battleships for training the large guns, working the turrets and ammunition hoists. As the steam turbine is attracting considerable attention nowadays, the description of the Parson's turbo-generator outfit as used on their torpedo boats is of great interest. The wiring of a ship is also very nicely described, also different systems of night signaling with incandescent lamps, and the construction and management of different kinds of searchlights on battleships, torpedo boats, etc. Although the practice in the Austrian Navy differs somewhat from that of the American Navy and merchant marine, and the designs may seem somewhat strange, the principles nevertheless remain the same. The book is very profitable reading matter for any grade of sea-going electricians, and a translation of the same would, without doubt, be highly appreciated.

TRANSACTIONS OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS. Vol. 5, 1897. Edited by the Secretary. Office of the Society, 12 West Thirty-first street, New York. Size, 9 by 11. Pages of text, 247. With many drawings and engravings. Cloth, $10.00.

There is no naval architect, engine designer, or shipbuilder in the country who can afford to leave vacant the place which this volume should occupy on his shelves. Indeed a set of the Transactions is about the most profitable investment in the way of marine literature that we know of. Each volume is a review of the most interesting features of marine practice for the day, which has distinct present professional and commercial value, and in time to come will be of great historical interest. Volume V contains the papers which were read at the fifth general meeting, together with a complete report of every discussion. The discussions, which were participated

in by those in attendance at the meeting, are supplemented by written communications received later, from members who were unable to be present. We need not here reproduce the names of papers and authors, for our readers will doubtless recollect the extensive report of the meeting published in our December issue. A most valuable feature of the Transactions is the number and character of the drawings and sketches which accompany the papers. The make-up of the volume is especially praiseworthy. The pages are well proportioned, the text is set in a large and very readable face of type, the paper is excellent, and the drawings are presented with great distinctness and are of a very workable size. Indeed, in the whole make-up and presentation the Transactions of the Society of Naval Architects and Marine Engineers are superior to anything of the kind that we know of—in the English language.

THE RESISTANCE AND PROPULSION OF SHIPS. By William F. Durand, Principal of the School of Marine Construction, Cornell University. New York, John Wiley & Sons. First edition, 1898. Size, 6 by 9. Pages 431. With 116 figures. Cloth, $5.00.

In marine construction to a greater extent, perhaps, than any other branch of applied science it is unfortunately true that those who know things cannot or will not write of them, and those who do write, often add but little to the recorded knowledge of the subject. It naturally follows that when a work is produced in which the author knows whereof he writes, has something worth writing about, and also knows how to impart the results of his research so that the competent reader cannot but comprehend, he will have an immediate and attentive audience. Such briefly is the character of Prof Durand's work. It is most timely, for there is no branch of shipbuilding practice in which the need of scientific guidance is more felt than in that of design. Competition, not merely of companies or yards, but of nations, has made so important questions of first cost, speed, accommodation, carrying capacity and operating expenses that rule of thumb methods are rapidly becoming unprofitable if not impossible. The work just issued is not offered as a substitute for practical skill and experience, nor as a "table of reference" from which the designer can pick out off-hand any given set of dimensions for any and all conditions. It is rather an aid or guide to the intelligent working out of the proper components of design. It is an unusual blending of the really practical and strictly theoretical, a book that can be read and understood from either standpoint with, of course, the fullest measure of profit when studied from both. There is a woful scarcity of such literature available for ready reference in the drawing room. As the author remarks in his preface, "of the few books in English published in this period (about twenty-five years) those of the highest value have been restricted either in scope or in mode of treatment." He then refers to the publication of isolated papers, on the subject in the transactions of various engineering and scientific societies; but these are, of course, inaccessible to the man in the yard, who has not a national library at his elbow. The book treats of the subject in six chapters entitled: Resistance, Propulsion, Reaction, Between Ship and Propeller, Propeller Design, Powering Ships, and Trial Trips. In the limits of a paragraph it is not possible to give in detail the treatment of each heading. It may be said that each opens with a general statement preparing the way for the more minute treatment which follows, the several components being treated in an orderly and scientifically accurate manner. The chapter on Propeller Design is especially valuable in view of the author's known investigations of this most obscure of all subjects in marine construction. This chapter is made more complete by tables giving data relating to ship and propeller performances on a large number and variety of steam vessels, from warships and passenger steamers to launches. Throughout the work free use is made of graphic exposition of the text. We can recommend this book to the careful attention of those who seriously desire to investigate the laws governing the Resistance and Propulsion of Ships.

MODEL ENGINES AND SMALL BOATS. *New Methods of Engine and Boiler Making, with a chapter on Elementary Ship Design and Construction.* By Nevil Monroe Hopkins. New York, D. Van Nostrand. Size, 6 by 8. Pages 74. With 50 illustrations. Cloth, $1.25.

The purpose of this book appears to be for the exploitation of a special system of construction used by the author, in which the "soldering iron" plays an important part. With a few tubes and sheets of brass as the chief materials, and this convenient instrument, the author shows how to construct small direct acting screw engines and shell and water-tube boilers. The method is ingenious, and would likely prove satisfactory to the amateur who had no knowledge of or taste for the more substantial and workmanlike methods of engineering construction, which embrace the use of castings, machined parts and carefully made screwed and faced joints. Considering the crudeness of the method, however, the designs, as shown, are remarkably good imitations of more thorough workmanship, and the simplicity of construction would probably awaken an active interest among those who would never undertake model work upon conventional lines. Though the work is a useful addition to the scant literature on the subject it would have much better accomplished its purpose had it been carefully edited. There is a noticeable want of comprehension of the subject as a whole, and a lack of orderly systematic arrangement throughout. In places the author plunges into little details without any recognition of principles, and the book is a collection of workshop notes, rather than a comprehensive treatise. A table of dimensions could have been added with much benefit. The illustrations are plainly drawn and should be easily understood.

We have received a copy of the valuable United States Standard Register of Shipping for 1898, published by the United States Standard Steamship Owners, Builders and Underwriters' Association, Limited, 18 Exchange place, New York. This contains, at great length, the rules of the association for the construction and classification of iron, steel and composite vessels, illustrated by an extensive series of drawings. The association is the exponent of the channel system of framing, which has been successfully applied to ships of various dimensions, on both fresh water and ocean service. Rules are also given for the survey and construction of machinery and boilers of steam vessels, and for the use and application of electric lights and appliances on board of ships. There are also extensive tables of scantlings for iron and steel vessels for the coastwise, West Indian and South American trades, and also for transatlantic service. Yachts also receive attention and much data are given concerning the construction of wooden vessels. The Register of Shipping fills nearly eighty pages, and includes the survey records of home and foreign vessels of all descriptions. At the end of the Register there are reproduced a number of letters from leading builders and shipowners expressing confidence in the work of the association.

Fatigue of Metal in Wrought Iron and Steel Forgings, a valuable paper by H. F. J. Porter, of the Bethlehem Iron Co., read before the Franklin Institute of Philadelphia, is issued in pamphlet form and can be had upon application to the company.

TRADE PUBLICATIONS.

"About Traps" is the title to a 3 1-2 in. by 5 1-2 in. neatly printed pamphlet received from the William S. Haines Co., 136 South Fourth street, Philadelphia, Pa. Those interested in traps will find much in this little book to interest them.

An attractive catalogue of over eighty pages, well illustrated, of the various products of the Diamond Rubber Co., Akron, Ohio, is received. These products comprise belting, hose packing and many other rubber goods, such as are used in various branches of marine work.

The Globe Iron Works Co., Minneapolis, Minn., sends us a catalogue of the White gas engines. These engines are made for both stationary and marine work and both types are illustrated and well described. Those interested in gas engines will find a copy of this catalogue worth having.

A catalogue on hose has been issued by the Boston Belting Co., 256 Devonshire street, Boston, Mass. It is 3 1-2 in. by 6 in. in size and comprises twenty odd pages, well illustrated, giving much information regarding the subject of hose and all appliances connected therewith. Copies can be had upon application.

"Friction" is the title of a pamphlet published by the A. W. Cadman Mfg. Co., 63 Water street, Pittsburg, Pa., describing the anti-friction metals manufactured by this company. It contains quite a number of flattering testimonials from some of the most prominent concerns in the country now using these metals, and some detailed information regarding the metal.

The Diesel motor, which has attracted so much attention of late in scientific and engineering discussions, is now being introduced into this country by the Diesel Motor Co., 11 Broadway, New York. Handsomely published catalogues are now ready for distribution, giving a great deal of information regarding this motor as well as a history of its development.

The 1898 catalogue of the Rochester Automatic Lubricator Co., Rochester, N. Y., is received. It comprises forty neatly printed pages and contains a good deal of information regarding these lubricators, which are extensively used in both marine and stationary work. The lubricator is well illustrated and many complimentary letters are published from the users of it.

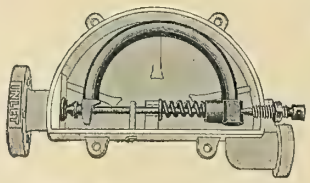
The Lunkenheimer catalogue for 1898 is just received. It is 5 in. by 7 in. in size and comprises 208 closely printed and thoroughly illustrated pages. There is a good deal of information in these pages regarding the brass and iron valves, injectors, whistles, lubricators, oil and grease cups and many other specialties manufactured by this company. Many tables of other important matter for engineers are also given. Any of our readers can secure a copy of this catalogue by mentioning this publication and sending to the Lukenheimer Co., Cincinnati, Ohio.

Two exceedingly handsome catalogues are received from the Sprague Electric Co., 20 Broad street, New York. One is devoted to the "Lundell" fan motors, and has a rich green cover printed in red and gold. The twenty pages are fully illustrated and are splendid specimens of the printers' art. All types of fan motors are shown and considerable detail is given, and sectional views of this well known motor. The second catalogue is devoted to electric motors in the art of printing. It is equally as fine a specimen of press work and is a catalogue which every man should have who is at all interested in the subject of direct connected electric work.

23 Years

in constant use — and no failures. Thousands of dollars saved by the "Heintz" Steam Trap. Simple — Durable — Efficient. Works in any position — discharges water to any height. No floats, no levers or delicate parts. Economizes fuel and labor — saves space — perfectly automatic—requires no watching. Money refunded if trap proves unsatisfactory within a year. Send for one on thirty days' trial free.

Booklet "G" for the asking, will show you how to save money.



William S. Haines Company,
136 South Fourth Street,
Philadelphia.

"The Heintz—the best—tho' it has imitators."

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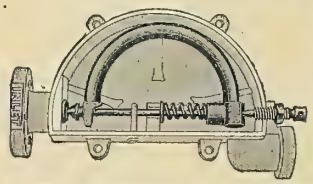
Efficiency

makes the value of the "Heintz" Steam Trap — lots of others where you get more iron for your money—lots of imitations, too—and some of them look almost exactly like the "Heintz."

Every puff of steam you lose means a loss of more or less money-profits gone. Use the "Heintz" on your outlets, wherever steam escapes, and you will have an increased boiler capacity. We have saved some concerns large sums—more than we dare say. Can save you something, too.

The cost? Of little moment when traps are needed. Booklet "G" tells the starting point. Get one from us.



William S. Haines Company,
136 S. 4th St., Phila.

"The Heintz—the best—tho' it has imitators."

21 COPYRIGHT, 1897, BY THE WHITMAN CO., N. Y. 2

Graphite Lubrication

There is no substance known so smooth or so enduring as **Dixon's Pure Flake Graphite.** It is the best solid natural lubricant ever discovered. It is not affected by heat or cold, acids or alkalies. It is absolutely indispensable to every marine, stationary or locomotive engineer.

It will pay you to send for Sample and Pamphlet. No charge.

JOSEPH DIXON CRUCIBLE CO.,
JERSEY CITY, N. J.

REDUCING VALVES

to control or reduce steam, water or air pressures.

"MASON"

Valves have had a world-wide reputation for years.

Write for prices.

THE MASON REGULATOR CO.,
BOSTON, MASS.

ANTI-FRICTION METAL.

Especially adapted for **HEAVY AND HIGH SPEED ENGINE BEARINGS AND ALL KINDS OF MARINE WORK.**
Outwears, runs cooler and with less lubrication than any babbitt or anti-friction metal made.
Descriptive Circular, Testimonials and Samples Free.
All Kinds of Superior Brass, Bronze, Copper and Non-corrosive White Metal Castings.

FENTON & CO., SELLING AGENTS,
39 Cortlandt St., New York.

Users of coal should have a copy of the finely printed pamphlet issued by the Toms Creek Coal & Coke Co., Norfolk, Va. Figures are given showing the large number of heat units in the coal furnished by this company, and many testimonials are given from some of the largest concerns in the country, that are apparently exclusive users of Toms Creek Coal. A map on the back of the book shows the location of the six collieries of this company.

The Cochrane Separator, manufactured by the Harrison Safety Boiler Works, Germantown Junction, Philadelphia, is very thoroughly illustrated and described in a catalogue just received. The catalogue is 6 in. by 8 in. in size and comprises thirty-six well filled pages, with an abundance of half tone engravings, sectional drawings and complimentary letters regarding this apparatus. Copies can be had by sending to the company and mentioning this paper.

"Light Draught Steam Boats and their Driving Machinery" is the title of a 6 in. by 9 in. pamphlet just received from the Marine Iron Works, Station A, Chicago, Ill. It is very neatly printed on coated paper and the pennant of the company is lightly printed in green ink on each page. The general type of boat manufactured by this company was shown in our January issue, but this pamphlet goes into more detail and gives much information of value to people interested in such boats. Six different types and outfits for Alaskan service are described.

BUSINESS NOTES.

METAL POLISH.—Owing to largely increased demand for Star metal polish, J. B. Cole, manufacturer of it, has moved to larger quarters at 80 Cortlandt street, New York.

BUSY BOAT BUILDER.—Two "Klondike" outfits have just been shipped to the Pacific coast by the Racine Yacht and Boat Works, Racine Junction, Wis., and among other orders are a 15 ft. sailboat and a 20 ft. tugboat for towing logs in northern Wisconsin, the motive power being a gasoline motor; also launches for Florida and for Mexico.

REMOVAL.—Robert A. Keasbey has found it necessary to move and hereafter his office and salesroom will be at 83 Warren street, New York, instead of at 54 Warren street, where he will carry an extensive stock of pipe coverings, paper felt, etc. His Buffalo office still remains at 13 Terrace.

THE LARGEST MOTOR POWER BOAT.—What is said to the largest motor power yacht afloat has just been built at the Daimler Motor Works, Steinway, Long Island City, N. Y. This yacht is the "Coyote" and is 86 ft. long over all, 14 ft. beam, 4 ft. draught, and is equipped with two 25 horse power Daimler motors, each operating its own shaft. This boat has a speed of 12 miles an hour. She has been bought from the Daimler Co. by Eugene Peters, Washington, D. C. Yachtsmen interested in the subject can have full information and a picture of this fine boat by applying to the company.

EFFICIENT REFRIGERATION.—A letter received by the Kilbourn Construction Co., 935 Drexel building, Philadelphia, Pa., from the superintendent of the Vacuum Oil Co., contains the following paragraph which is highly complimentary to the Kilbourn ice machines: "The 9 by 30 ammonia compressor put in by Mr. J. K. Kilbourn in 1890 has run continuously night and day from that time up to the present, and during this period we have only expended about $4 on repairs for this machine. We take great pleasure in giving you this information, as we consider this machine one of the best on the market, both as to efficiency and durability. We claim that this is an extremely hard test on the machine when you take into consideration that we are running our ammonia temperatures somewhere from 10° to 20° below zero."

RAWHIDE PACKING.—The hydraulic rawhide packing manufactured by the Mabbs Hydraulic Packing Co., P. O. Box 829, Chicago, has been on the market for several years and is now used on ocean liners as well as on the lakes and rivers. This packing is composed of strips of rawhide and is very nearly antifrictional. It is well adapted to the many uses in steamship work, especially for propeller stern tubes.

STEAM JOINT CLAMP.—A new device that will interest steam engineers is the Climax Steam Joint Clamp manufactured by James McCrea & Co., 11 South Canal street, Chicago. These clamps will repair leaks on steam joints without pulling out the pipes or shutting down the engine. The clamps are easily put in position and take up very little space. Full information regarding them is printed in circulars.

SAFETY DEVICES.—The engine stops, speed limits and other steam safety devices illustrated in the advertisement elsewhere of the Monarch Manufacturing Co., are being placed upon the market by Mr. Albert Cary, 39 Cortlandt street, New York. Mr. Cary has been well-known for many years as the superintending engineer of the Abendroth & Root Mfg. Co. He has severed his connection with that concern and is now devoting his entire time to these specialties. They are well worth a careful investigation by conservative engineers.

MARINE FORGINGS.—Notwithstanding the fact that the Bethlehem Iron Company, South Bethlehem, Penn., have on their books large orders for guns, gun carriages and forgings for guns, the number of orders which they are taking for merchant work, such as shafting of various descriptions, both solid and hollow, and of plain steel as well as nickel steel, is increasing daily. The products of this well known concern have a world-wide reputation, as the booking of several contracts for armor plate for the Russian Government proved. Last week the company was asked to quote a price on shafting for a Japanese torpedo boat, which is being built in Japan.

ENGINEERING INSTRUCTION.—The American School of Correspondence, 156 Tremont street, Boston, Mass., offers special advantages to the readers of Marine Engineering to secure an education enabling them to pass government examinations. Any of our readers applying for information upon entering a course at once secure a reduction of 33 1-3 per cent. on the regular scholarship prices by mentioning Marine Engineering. The new hand book of this school indicates its scope and character. The instructors are specialists and devote their entire attention to engineering. The officers and instructors of the school are all well known, while the advisory board is composed of such noted experts as Dr. Robert Grimshaw, Charles Thom, Francis H. Boyer and others. Engineers will do well to write for the handbook as per instructions in another column.

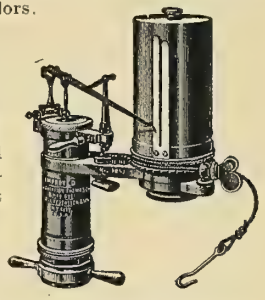
SEND 2 LABELS

cut from front of boxes of EUREKA PACKING and we will send you a pack of beautiful playing cards. All being special in 3 colors.

MARINE ENGINEERS

should own an INDICATOR and know how to use it. Send for circular and *special* prices. It will interest you.

Jas. L. Robertson & Son,
218 Fulton St., N. Y.



LAMPS

For Every Purpose.

We make lamps for Yachts, Boats, Boathouses, Cabins, Wharves, Walks, or anywhere, indoors or out, where a good strong light is wanted.

Our goods need no recommendation from us. They are the standard. Other lamps are said to be "equal to," "like," or "as good as"

THE NEW ROCHESTER.

To be sure the lamps offered you possess the merits peculiar to the genuine, insist on seeing the name stamped in the metal. Catalogue free. We give as much attention to making special lamps, repairs, etc., as to our regular line.

THE ROCHESTER LAMP CO.

42 Park Place and 37 Barclay St., New York.

MARINE ENGINEERS, ATTENTION!

THE AMERICAN SCHOOL OF CORRESPONDENCE

(Chartered by the Commonwealth of Massachusetts.)

Offers a SPECIAL COURSE in MARINE ENGINEERING.

This course has been planned by the foremost marine experts of this country, and is thoroughly practical and scientific.

We are SPECIALISTS, and teach ONLY

Engineering { STEAM / ELECTRICAL / MECHANICAL } { *STATIONARY* / *MARINE* / *LOCOMOTIVE* }

We do not **attempt** to teach anything and everything, but **do** teach the above courses thoroughly and well.
Our corps of trained instructors is selected from the best scientific schools of the country, and they devote their entire time to the students in the above important branches of mechanical science.
Thousands of enthusiastic students endorse and commend the progressive methods of our system of instruction.

SPECIAL OFFER TO READERS OF MARINE ENGINEERING.

33 1-3% DISCOUNT. For the next **30** days we will give readers of MARINE ENGINEERING a reduction of 33 1-3 per cent from our regular scholarship price (easy terms if desired). FOR 30 DAYS.
Your name on a postal card will bring you a handbook of the school, containing complete schedules of courses, pages from instruction papers, etc., etc.

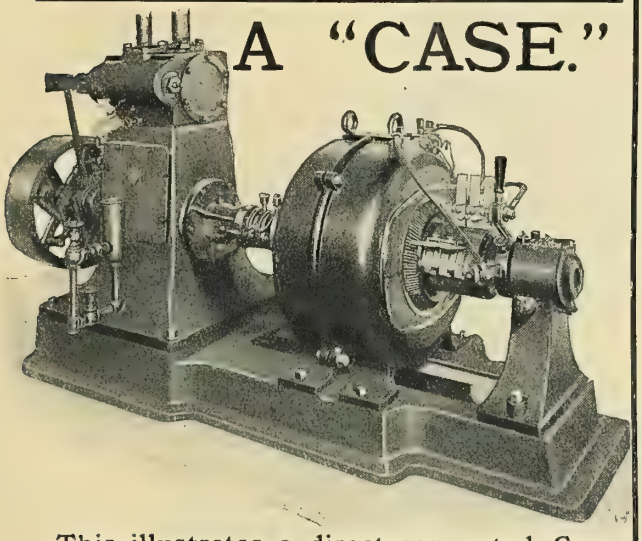
YOU CANNOT AFFORD TO MISS THIS OPPORTUNITY.

AMERICAN SCHOOL OF CORRESPONDENCE, 156 Tremont St., BOSTON, MASS.

EMPIRE MOTOR.—The Empire Motor which is illustrated in our advertising columns was put upon the market last year. It has already made a reputation for itself because of its compactness, simplicity and design. The principal feature is the control of the air supply, permitting the motor to be run at a very slow speed. These motors are of the four-cycle type. The company furnishes reversing gear or reversable propellers. The exhaust of these motors is under water and there are no moving parts on the outside except the fly-wheel. Lubrication is automatic, and the use of electric batteries has been done away with and the ignition current is generated mechanically by the revolving of the fly-wheel. All motors are double cylinder with the exception of the one horse power and they are made up to twenty horse power in size.

MARINE ELECTRIC LIGHTING PLANTS.—One of the standard engines for use in marine electric plants for years has been the "Case," manufactured by the New Britain Machine Co., New Britain, Conn. Two types of direct connected plants in which this engine is used are shown in our advertising columns this month. The one with the "Lundell" dynamo, manufactured by the Sprague Electric Co., New York, is the type that has been used by the Merchants & Miners Transportation Co. for the "Juniata," which was fully described in our December issue. This steamer is now the floating machine shop for the United States Navy. This plant has a capacity of 250 lamps of 16 candle power and takes up no more room than an ordinary rolled top desk. The other plant shown is a "Case" engine direct connected to an "Eddy" dynamo, manufactured by the Eddy Mfg. Co., Windsor, Conn. Several rigs of this kind have been furnished for use on Yukon river steamers. The many characteristic features of the Case engine are fully told and described in publications issued by the company. Every engineer interested in marine electric plants should send to the company for further details.

A "CASE."



This illustrates a direct-connected Case engine and Lundell dynamo, two sets of which are on the M. & M. Steamship Juniata, purchased by the government as a floating machine shop.

Send for particulars.

NEW BRITAIN MACHINE CO.,
NEW BRITAIN, CONN.

Look at the picture in our advertisement on page 57.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

POSITION WANTED.

A superintendent of works doing a general line of marine and stationary work, engineering, boiler and tank making, and general contracting, including jobbing and repairs, and who makes estimates, contracts, drawings, and follows up the work both in the shops and outside, wishes to change. Address "SUPERINTENDENT," care of MARINE ENGINEERING.

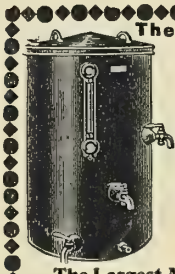
POSITION WANTED.

Mechanical Engineer, 15 years' experience in shop and designing; has handled men in own business; desires responsible position not confined to office; marine and general machinery. Address X, MARINE ENGINEERING.

PROFESSIONAL CARD.

H. B. ROELKER,

CONSULTING AND CONSTRUCTING ENGINEER.
Manufacturer of **Screw Propellers** for Usual and for Special Work.
The Allen Dense Air Ice Machine for Steam Vessels.
41 MAIDEN LANE, NEW YORK.



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THE BURT MANUFACTURING CO.
AKRON, OHIO, U. S. A.
The Largest Manufacturers of Oil Filters in the World.

GOLDEN'S PROPELLERS.—Captain Samuel Golden, 178 Ohio street, Buffalo, N. Y., is designer and maker of what he calls the "perfect propeller wheels." The captain has sailed on the lakes for many years, lately as master of the high speed yacht "Enquirer." A circular regarding these propellers can be had by applying for it.

MARINE ELECTRIC WORK.—Edward R. Knowles, for many years the engineer for electric instalment and consulting engineer for the Brooklyn Bridge and other large plants, has become manager of the power motor department of the Sprague Electric Co., 20 Broad street, New York. Being a specialist in this line, he is prepared to make any repairs for the installation of electric plants for steam vessels, shipyards or other marine uses.

MARINE ELECTRIC LIGHT PLANTS.—Morton, Reed & Co., Baltimore, Md., have been very busy this spring. They have just fitted up a new 125 ft. yacht for William H. Evans, of that city, with all necessary machinery, and have just sold three double cylinder direct-connected automatic engines with dynamos attached for lighting steam vessels. Full information regarding these engines can be had upon application. This firm has recently been appointed agent for the Sprague Electric Co., New York.

NEW JACKET TUBING.—The Excelsior Jacket Tubing is one of the recent products which the Boston Belting Co., 256 Devonshire street, Boston, Mass., is putting on the market. This tubing is neatly boxed and each box contains all necessary couplings and electric tape for winding the joints. It is of superior quality, and the coupling device is believed to be a considerable improvement over many old methods. A four-page folder regarding this tubing is sent to all inquirers.